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ERRATA

- No. 276.—Page 11, under Fig. 1, read *Puffinus thermindieri* for *Puffinus Ihmerindieri*.
 “ 286. —Page 9, line 11 from top, read subfamily for subfamilly.
 “ 297. Page 1, paragraph 2, line 4, read 1916 for 1927
 “ 297.—Page 10, paragraph 2, line 2, read Tarsidae for tarsidae.
 “ 297.—Page 13, line 2 from bottom, read Marsupialia for marsupialia.
 “ 297. —Page 15, line 5 from top, read “chyromyoid” for “chryomyoid.”
 “ 297.—Page 15, line 8 from bottom, read of for or.
 “ 298.—Page 1, footnotes 2 and 3, read Cockerell, T. D. A., for Cockerell, T. D. A. C.
 “ 298.—Page 4, line 4 from top, read to what extent for to what an extent.

- No. 298.—Page 4, paragraph 2, line 7, read absciss-line for absciss line.
- “ 306.—Page 5, in table, delete 111 before males and 11 before Females.
- “ 306.—Page 5, line 12 from top, read legs for cheeks.
- “ 312. Page 4, line 7 from bottom, read cuspule for cupsule.
- “ 323.—Page 10, line 8 from bottom, read *Cænolestidæ* for *cænolestidæ*.
- “ 328.—Page 1, line 2 from bottom, read *virginiana* for *virginana*.
- “ 329.—Page 3, line 5 from top, read there for their.
- “ 329.—Page 8, under Fig. 6, read Semidiagrammatic for Semidiagramatic.
- “ 330.—Page 1, line 1 from bottom, read Museum Novitates No. 329 for Museum Novitates No. 84.
- “ 330.—Page 2, line 12 from top, read *lechei* for *lechi*.
- “ 330.—Page 4, line 23 from top, read Leptictidæ for leptictidæ.
- “ 330.—Page 4, line 12 from bottom, read group most nearly for group most.
- “ 330.—Page 5, line 1 of caption, read cheek teeth for cheek.
- “ 330.—Page 6, line 3 from top, read latter for matter.
- “ 333.—Page 3, line 1, read 1928 for 1918.
- “ 333.—Page 4, under Fig. 1, read Diagrammatic for Diagramatic.
- “ 333.—Page 4, line 2 from bottom, read muscles for musles.
- “ 333.—Page 13, line 8 from bottom, read fossæ for fosse.
- “ 333.—Page 15, line 2 from top, read peculiarity for peculiarly.
- “ 333.—Page 15, line 3 from top, read incisors for incisors.
- “ 333.—Page 18, line 14 from bottom, read 1929 for 1928.
- “ 333.—Page 18, between lines 14 and 15 from bottom insert: Granger, W. 1915.
New Evidence of the Affinities of the Multituberculata. Bull. Geol.
Soc. America, XXVI, 152.
- “ 339. Page 12, line 23, from top, read Bailly Island for Balky Island.
- “ 345.—Page 9, line 2 from bottom, insert a comma after frugal.

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ON CERTAIN FORMS OF *PUFFINUS ASSIMILIS* AND ITS ALLIES

BY ROBERT CUSHMAN MURPHY

The small shearwaters related to *Puffinus assimilis* have presented a complicated problem to taxonomists, as shown by the tenor of numerous discussions published during the last thirty years. The more important references are the following:

- 1899. Rothschild, W., and Hartert, E., *Novit. Zool.*, VI, pp. 194-197.
- 1912. Mathews, G. M., 'Birds Austral.', II, pp. 50-73.
- 1918. Loomis, L. M., *Proc. Calif. Acad. Sci.*, (4) II, part 2, No. 12, pp. 122-129.
- 1920. Hartert, E., 'Vögel Paläarkt. Fauna,' II, pp. 1421-1423.
- 1926. Hartert, E., *Novit. Zool.*, XXXIII, pp. 349-356.

In addition to studying the evidence and conclusions presented in these papers, the writer has enjoyed the courtesy of seeing proof-sheets of Mr. Gregory M. Mathews's forthcoming list, 'Systema Avium Australasianarum,' which contains certain modifications of this author's former views regarding the birds concerned.

The American Museum of Natural History now possesses examples of these small shearwaters from many parts of the world, a number of forms being represented by large series. The present systematic notes are based not only upon these but also upon skins examined in European Museums during the summer of 1926. Data for a new review of all the subspecies are not available, but, if it be possible to fix the status of several hitherto doubtful forms and to substantiate a division of the group into two species which exhibit a definite geographic correlation, the purpose of this small contribution will be served.

Let us begin with a schematic consideration. A, B, C and D, E, F represent six races of a small, white-breasted, dark-backed *Puffinus*. On ordinary systematic grounds they might all be treated as subspecies of a single species, a course which Dr. Hartert and others have followed. But a study of the specimens shows that A, B, and C are much more closely allied with one another than any of them is with D, E, or F. A similar generalization is likewise applicable to the races of the latter group. When, furthermore, the complex of forms which we may now designate A B C is found to inhabit a distinct climatic or oceanographic zone from D E F, and it appears that each group has "subspeciated"

freely within the limits of its own zone, we may reasonably regard the main groups as specifically distinct. Classification is in large measure a matter of convenience, but the writer believes that in this instance specific differentiation will better reflect the evolutionary and geographic history of the birds, besides facilitating the identification of specimens.

Among the differences between the two groups, Mathews (1912, p. 68) has stressed that one is made up of birds with "blue-black" and the other of birds with "brown-black" upper surfaces. Loomis (1918, p. 122) holds, on the other hand, that "intergradation is complete between the brownish-backed and bluish-backed birds." The writer's experience with three hundred specimens from about thirty localities in the Atlantic, Indian, and Pacific Oceans confirms the opinion of Mathews. Regardless of age or state of plumage, a glance at the dorsal aspect of any specimen has thus far been sufficient to assign it to either the "blue" or the "brown" groups. Moreover, such allocation can always be checked by inspection of the primary quills, which distinguish birds of the respective groups with equal constancy.

The distinctions may be more fully set forth as follows:

1.—Upper surface varying in the different races between slate color and slate black, fading greatly with extreme wear, but always without a trace of brown hue in fresh feathers; inner vanes of the primaries largely white; under tail-coverts mostly white (entirely so among all forms examined except the Madeiran race); part of loreal space between culminicorn and angle of mouth, white; color of legs in life, blue. Range: extratropical seas, chiefly in the temperate zone beyond 30° S. latitude, but with one north temperate race (at Madeira) *Puffinus assimilis*.

2.—Upper surface varying from blackish brown to sooty black, but always brownish rather than slaty; inner vanes of primaries without white; under tail-coverts largely or entirely dark; part of loreal space between culminicorn and angle of mouth, mostly dark; color of legs in life, flesh color. Range: tropical seas, extending just north of the Tropic of Cancer at the Bonin and Bahama Islands, and to an isolated northern outpost at Bermuda. *Puffinus lherminieri*.

***Puffinus assimilis assimilis* Gould**

Puffinus assimilis Gould, 1838, 'Synops. Birds Austr.,' part 4, Append. p. 7 (New South Wales=Norfolk Island).

Mathews and Hartert now agree in regarding birds from Lord Howe Island as identical with topotypes. The American Museum has received as a gift from the Zoological Museum at Tring two males taken at Roach Islet, Lord Howe Island, June 24, 1914. They represent a short-billed race, with the characteristic slaty-black upper surface. The entire lining of the wing is white. The white area of lores and cheeks passes well above the eye, a few dark feathers speckling the orbital ring. The bill

in life was "blue and black," and the feet "clear blue" with the usual dark color on the outer side of tarsus and third toe.

MEASUREMENTS.—Wing, 171–173 (172); tail, 63; exposed culmen, 24–25 (24.5); depth of closed bill at base, 8–8.7; width of bill at base, 9.2–9.6; tarsus, 35–36 (35.5); middle toe with claw, 41–42 (41.5) mm.

***Puffinus assimilis kermadecensis*, new subspecies**

SUBSPECIFIC CHARACTERS.—Differs from *Puffinus assimilis assimilis* of Lord Howe Island in its larger size, which is especially noticeable in the length of the tarsus and middle toe.

TYPE.—No. 254107, Amer. Mus. Nat. Hist.; ♂ ad.; Herald Island, Kermadec Group, Nov. 19, 1925; R. H. Beek.

LOCALITY.—Kermadec Islands, Dominion of New Zealand.

Mathews united the Kermadec race with typical *assimilis*, but Hartert (1926, p. 350) pointed out that "the Kermadec birds require a new name, as they have larger bills than the Norfolk and Lord Howe specimens." However surprising it may seem to find a distinct form at islands lying on approximately the same parallel of latitude as Lord Howe and Norfolk, the excellent series at hand admits of no doubt in the matter.

During field work of the Whitney South Sea Expedition, Mr. R. H. Beek and his associates collected forty specimens of this shearwater on or adjacent to Herald and Sunday (Raoul) Islands of the Kermadec Group. The dates extend from Nov. 8 to 19, 1925, and the material includes young birds in advanced downy stages as well as adults. A few of the latter had enlarged gonads, as though the breeding period were still in progress.

From the gray down, which is whitish along the belly and leaden above, the chicks molt into a clear blackish-slate dorsal plumage, with a lighter slaty bloom on the quills and coverlet. No feathers show any trace of white margins, but the inner webs of the primaries are pure white over more than half of their width as in all members of the species as restricted in this paper.

Adults appear to be indistinguishable in color and pattern from typical *assimilis*, but all dimensions are larger. Bill, bluish with a black culmen; feet and legs, bluish, the outer toe and outer side of tarsus black.

MEASUREMENTS (10 ♂, 5 ♀).—Wing, 179–201 (190.5); tail, 62–71 (65.5); exposed culmen, 24–27 (26.1); depth of closed bill at base, 8–9.5, least depth of bill, 5.5–6; width of bill at base, 9–10.5; tarsus, 38–42 (39.6); middle toe with claw, 42–46 (44.3) mm.

Females appear to equal the males in size. Curiously enough there are but five adult females in the whole series.

***Puffinus assimilis*, subspecies**

An adult male, Amer. Mus. Nat. Hist. No. 254141, was collected by Mr. Beck in lat. 35° S., long. 175° W., a point about equidistant from the Kermadecs and the North Island of New Zealand, on Dec. 10, 1925. Its extremely long and heavy bill distinguishes it sharply from the Kermadec race, and still more so from typical *assimilis*. The wings and tail, though greatly worn, still indicate the large size of its subspecies. In pattern and color, and description of soft parts, it agrees with the preceding forms, its somewhat lighter dorsal surface being probably attributable to fading.

MEASUREMENTS.—Wing (much abraded), 199; tail, 69; exposed culmen, 29.5; depth of closed bill at base, 10.5; least depth of bill, 7; width of bill at base, 11; tarsus, 39; middle toe with claw, 46 mm.

Mathews (1912, pp. 53, 62, 63, and 69) has given scattered, confused, and defective descriptions of *Puffinus assimilis kemp*i, a new race ascribed to the Chatham Islands, and of *Puffinus assimilis gavia* (Forster), the type locality of which is Queen Charlotte Sound, New Zealand. There is some question about the validity of the name *gavia* as applied to a race of *assimilis*, besides which, the writer has seen no New Zealand specimens for comparison with the American Museum bird. The skin does not agree with Mathews' sketchy description of *kemp*i, so identification must await the arrival of further material.

***Puffinis assimilis munda* (Salvin)**

Nectris munda Salvin, 1876, 'Rowley's Ornith. Miscell.,' I, p. 236 (lat. 48° 27' S., long. 93° W. of London).

Salvin's description of this shearwater was based upon the manuscript records of Banks and Parkinson, accompanied by a pencil drawing. Mathews (1912, pp. 59, 60) has since published Solander's detailed Latin diagnosis. The type, which was collected on Feb. 15, 1769, was not preserved, nor have additional specimens since come to light until the Whitney South Sea Expedition collected six in lat. 49° S., long. 179° W. (south of Antipodes Island), on Feb. 16, 1926. It is a curious coincidence that after one hundred and fifty-seven years, almost to a day, the lost form should be recovered at practically the same parallel of south latitude. The east-west distance between the type locality and the place of capture of our specimens is about 815 nautical miles, but Solander's beautiful description leaves little doubt as to their identity.

SUBSPECIFIC CHARACTERS.—A large, but relatively short-billed, race of *Puffinus assimilis*, the feathers of the slaty dorsal plumage narrowly margined with white.

TYPE.—Non-existent.

REFERENCE SPECIMEN OR NEOTYPE.—No. 211650, Amer. Mus. Nat. Hist.; ♂ ad.; lat. 49° S., long. 179° W., Feb. 16, 1926; R. H. Beck.

ADULT (sexes alike). Entire upper surface close to slate color (not exactly matched in Ridgway's 'Color Standards,' but Solander's terms "ashy-blackish" and "steely-blackish" are suggestive), the feathers of nape, sides of neck, back, wing-coverts, secondaries, and tail-coverts margined with white, most broadly (2 mm.) on the external and terminal parts of the secondaries; concealed portions of dorsal feathers grayish white; inner two-thirds of inner vanes of primaries white to within 20 or 25 mm. of their tips; pileum slightly more blackish than back, and lacking white borders on the feathers; lores speckled, white on their lower halves, the dark color of the pileum descending below and behind the eye, with a mottled boundary; a narrow white stripe on the lower eyelid; sides of breast covered with slaty, white-margined feathers which blend gradually with the uniform white plumage of the ventral surface; lining of wings and under tail-coverts white like throat and breast. Bill blackish above and terminally, blue on the mandible and toward base of culmenicorn; feet and legs blue, with the outer toe and outer side of tarsus blackish.

MEASUREMENTS (3 ♂, 3 ♀).—Wing, 182-196 (190.5); tail, 64-69 (66.8); exposed culmen, 24-27.5 (25.8); depth of closed bill at base, 8.4-10; least depth of bill, 6-6.6; width of bill at base, 10-11.5; tarsus, 39-41.5 (40.3); middle toe with claw, 45-48 (47.1) mm.

All the specimens, which are apparently adults, had small gonads. Two are in more worn plumage than the others and show that the delicate white fringing on the feathers of the upper surface tends to wear away, leaving a uniform gray appearance.

There can be little doubt that *Puffinus elegans* Giglioli and Salvadori, described from the South Atlantic, is close to this form. Mathews states that *elegans* is the Gough Island bird, in which case *Puffinus assimilis munnai* perhaps represents a race or type of the species which occurs south of the northern limit of drift ice throughout the subantarctic oceans.

Puffinus assimilis godmani Allen

Puffinus godmani Allen, 1908. Auk, p. 339 (Madeira).

The Madeiran race is the most isolated member of the species, the only one, so far as available material shows, which has crossed the equatorial regions into the northern hemisphere. Its distinctness from the brown-backed, tropical shearwaters of the West Indies and the Cape Verde Islands is highly noteworthy as a zoogeographic phenomenon.

P. a. godmani bears a close general resemblance to typical *P. a. assimilis*, but most specimens of the former show a dusky wash on the outer vanes of the lateral under tail-coverts. Moreover, the white area on

the inner webs of the primaries, which is less extensive in *godmani* than in other subspecies, is finely sprinkled or mottled with gray instead of being pure white. Finally, *godmani* has a relatively longer and more slender bill than the southern subspecies of similar size and appearance.

The material examined comprises specimens labelled Madeira, Porto Santo, the Desertas, and Bugio Island, collected in Feb., June, July, and Sept., together with a typical example (young?) in the Dwight collection, which was taken near Sable Island, Nova Scotia, Sept. 1, 1896.

MEASUREMENTS (4 ♂, 4 ♀).—Wing, 172–187 (176.9); tail, 63–72 (67.1); exposed culmen, 25.5–28 (26.6); depth of closed bill at base, 7.6–8.5; least depth of bill, 4.5–5; width of bill at base, 7.6–8.7; tarsus, 35.5–39 (37.1); middle toe with claw, 40–42 (41.1) mm.

***Puffinus lherminieri lherminieri* Lesson**

Puffinus lherminieri Lesson, 1839, Rev. Zool., II, p. 102 ("Ad ripas Antillarum").

Audubon's shearwater is the typical form of the group characterized by a "brown-black" upper surface and other features listed in the key. The material examined includes an excellent series in The American Museum of Natural History, as well as the type skin of *P. auduboni* Finsch, in the Berlin Museum, and other specimens in foreign collections. Localities represented by the measured skins comprise Barbados, Guadeloupe, St. Thomas, Florida, the Bahamas, Bermuda, Cobbs Island, Va., and Bellport, N. Y.

During the course of the Brewster-Sanford South American Expedition, Mr. R. H. Beck took numerous adults from their burrows on a small islet off the northern end of Barbados, on July 30, 1916, and others at Little Saba Island, St. Thomas, on Aug. 21, 1916. The specimens had already begun to molt, a process which seems to go on among the West Indian shearwaters throughout the summer.

Downy young, in various stages of growth, are well represented in the American Museum collection by birds taken at the Bahamas, St. Thomas, and Guadeloupe during the month of May. The down gives place to a plumage of the adult type, the dorsal surface being of a nearly uniform hue, close to the blackish brown (3) or the fuscous black of Ridgway, without white feather margins except at the sides of the breast.

The lores in this subspecies are mostly dark, with no more than a narrow line of white from the bill to the angle of the mouth. The inner vanes of the primaries, as in all forms of the species, lack white; the lower tail-coverts are mixed but prevailing dark, and the axillaries

and under coverts of the wing are rarely if ever without at least a few dark splotches.

The bill is both long and heavy, though subject to considerable variation. For example, a female taken off its egg at Washerwoman Key, Bahamas, May 15, 1902, has an exposed culmen of only 26 mm. This is nearly 4 mm. below the average of 26 adults, among which the next shortest bill measures 28 mm. Further consideration of such variations will be given under another subspecies. Sexual variation seems to be slight and inconstant.

Bill, black, bluish on the mandible and toward the base of culminicorn; feet and legs, flesh color, with the outer toe and outer side of tarsus blackish.

MEASUREMENTS (26 ♂ and ♀, collected at all seasons).—Wing, 200-216 (208.2); tail, 82-94 (87.2); exposed culmen, 26-32 (29.8); depth of closed bill at base, 9-10.8; least depth of bill, 6-7.5; width of bill at base, 10-13; tarsus, 39-43 (40.3); middle toe with claw, 43.5-48 (45.8).

***Puffinus lherminieri boydi* Mathews**

Puffinus lherminieri boydi Mathews, 1912, 'Birds Austral.,' II, p. 70 (Cape Verde Islands).

This form is substantially a counterpart of the West Indian race in color and proportions, but is very much smaller. The writer previously assigned it to *assimilis* (1924, Bull. Amer. Mus. Nat. Hist., L, pp. 240, 241), but he now concedes that Mathews and Bannerman were right in pointing out its close affinity with the tropical brown-backed and dark-primaried group. Its relationship with the north temperate Madeiran race is as remote as that between any forms of *assimilis* and *lherminieri*.

MEASUREMENTS (2 ♂, 2 ♀).—Wing, 169-180 (176.9); tail, 71-80 (76.5); exposed culmen, 24-29 (26.6); depth of closed bill at base, 7-7.5; least depth of bill, 4.6-5; width of bill at base, 10; tarsus, 37-39 (37.5); middle toe with claw, 40-44 (42.5) mm.

***Puffinus lherminieri subalaris* Ridgway**

Puffinus subalaris Ridgway, 1897, Proc. U. S. Nat. Mus., XIX, p. 650 (Chatham Island, Galapagos).

Puffinus lherminieri becki Mathews, 1912, 'Birds Austral.,' II, p. 79 (Culpepper Island).

The American Museum possesses specimens from Wenman, Culpepper, Hood, and Duncan Islands, collected during the months of Jan., Feb., Apr., May, June, and August.

The characters of the subspecies have been fully discussed by the

describer, by Rothschild and Hartert (1899), and by Loomis (1918). Making allowance for every recorded color variation, the race seems to be marked by the absence of dark areas descending from the back over the sides of the chest and by the prevalence of dark feathers on the flanks. From *P. l. lherminieri* it differs also in both size and proportions, the tail being relatively as well as absolutely shorter. A curious feature, which appears to distinguish *subalaris* from every other form of either *lherminieri* or *assimilis* which has passed through the writer's hands, is that the nasal tubes of the Galapagos race are exceptionally firm and corneous, showing almost no trace of shrinkage in dried skins.

Loomis has satisfactorily disposed of Mathews's description of a second subspecies inhabiting the Galapagos Archipelago.

The dimensions of ten American Museum specimens agree remarkably well with those of ninety-nine recorded by Loomis.

MEASUREMENTS (5 ♂, 5 ♀).—Wing, 189-203 (194.8); tail, 68-75 (71.8); exposed culmen, 24.7-29 (27.7); depth of closed bill at base, 9-10; least depth of bill, 6-6.5; width of bill at base, 10.5-12; tarsus, 34-37 (36); middle toe with claw, 40-43.6 (41.3) mm.

***Puffinus lherminieri polynesiae*, new subspecies**

Extensive collections in The American Museum of Natural History show that the central part of the South Pacific Ocean, from the Marquesas and Tuamotu Islands westward within the tropics to Samoa, is occupied by a uniform race of brown-backed *Puffinus*, larger than *subalaris*, smaller than typical *lherminieri*, but resembling the latter in the extent of dark, white-edged plumage which descends down the sides of the neck and chest toward the mid-line. In short, this is the race of tropical Polynesia.

Westward, toward Australia, a very distinct subspecies is found. Northwestward, toward and across the equator, or in the region extending from the Phoenix Islands through the Gilberts and Carolines to the Pelew Group, is still another race, resembling the Polynesian form but with a very short bill. Still farther northward, just beyond the tropic of Cancer at the Bonin Islands, is the home of a fourth, extremely well-marked subspecies. These several forms will all be considered in turn.

It would be natural to conclude on geographic grounds that the Polynesian race is the *Procellaria obscura*, of Gmelin, the type locality of which was said to be Christmas Island. Mathews has, however, discarded this specific name because of alleged confusion of forms in its original application,¹ a step in which he has been supported by Hartert

¹Cf. also Pelzeln, 1873, *Ibis*, pp. 47-51, and Matthews and Iredale, 1915, *Ibis*, p. 596.

(1920, p. 1422). The writer regards the intricacies of nomenclature as the most distasteful and least profitable phase of ornithological research, and he prefers to leave the solution of this patent case to others while he attempts to fix the taxonomic, rather than the nominal, status of the forms which occupy certain definite Pacific areas.

It may be said that two recent visits by representatives of the American Museum and the Bishop Museum of Honolulu failed to disclose the presence of the small *Puffinus* at either Christmas or Fanning Islands. If, however, future workers conclude that the name *obscura* is tenable, the nomenclatural changes involved will be simple. The bird here described as *Puffinus therminieri polynesiae* will become *Puffinus obscurus obscurus* (Gmelin), while *therminieri* will remain only as the subspecific name of the West Indian race. The distinction between the species *assimilis* and *therminieri*, as conceived in this paper, will not be affected.

The Polynesian bird may meanwhile be diagnosed as follows:

SUBSPECIFIC CHARACTERS.—Resembling *Puffinus therminieri therminieri*, but smaller, with a more slender bill; larger than *P. l. subalaris*, especially in length of tail and tarsus, and differing, furthermore, in the presence of an extensive dark area at the sides of the pectoral region, and in having noticeably shorter and less corneous nasal tubes.

TYPE. No. 189740, Amer. Mus. Nat. Hist.; ♂ ad.; Tahiti, Society Islands, Aug. 2, 1921; R. H. Beck.

RANGE. Society, Tuamotu, Marquesas and Samoan Islands, and doubtless other groups in the central part of the tropical South Pacific.

MEASUREMENTS (26 ♂ and ♀, 1 Tahiti, 4 Marquesas, 10 Tuamotus, 8 Samoa). — Wing, 188–212 (202.9); tail, 75–84 (80.1); exposed culmen, 25.5–30 (28.9); depth of closed bill at base, 8–10; least depth of bill, 5.5–6; width of bill at base, 9–11; tarsus, 37.5–41 (39.2); middle toe with claw, 39–43 (41.4) mm.

The material comprises large series of skins, collected by Messrs. R. H. Beck, J. G. Correia, and others, during the explorations of the Whitney South Sea Expedition, as follows:

Society Islands, 1921: Tahiti, Aug. 2, adults, gonads small, "breeding finished." Tuamotu Islands, 1922: Mangareva (Makaroa islet), May 3, nesting adults and a fledgling which had nearly lost the down; (Motu Teiko islet), May 4, adults, and young in all stages of growth; (Manui islet), May 8, adults and young. Marquesas Islands, 1923: Hatutu, Oct. 10, breeding adults and a half-grown downy young; Huahuna (Uahuka), Nov. 11, one nesting female. Samoan Islands, 1923: Tau, Manua Group, Dec. 26, 27, breeding adults with enlarged gonads.

Bill black, dark bluish or bluish gray on mandible and at base of culminicorn; feet flesh-color, outer toe and outer side of tarsus blackish.

Length in flesh (♂, Tahiti), 330, extent of wings, 665; (♀, Tahiti), length, 325, extent, 652.

Downy young are of a distinctly lighter gray above than those of *P. l. lherminieri*, while the ventral surface is entirely grayish white (pallid neutral gray of Ridgway) instead of purplish gray with a light central area. The color of fresh dorsal plumage in adults is substantially like that of the West Indian race, though perhaps a shade darker. The crissum and shorter under tail-coverts are white, the other coverts dark, those of intermediate length having whitish tips. The wing lining is prevailingly white, dark feathers being present among many specimens, but to a lesser extent than the average in *P. l. subalaris*. White feather edgings never appear on the dorsal surface in any stage of growth, but they are present on the dark plumage at the sides of neck and chest.

***Puffinus lherminieri* dichrous Finsch and Hartlaub**

Puffinus dichrous Finsch and Hartlaub, 1867, 'Faun. Centr. Polyn.,' p. 244 (McKean Island, Phoenix Group).

?*Puffinus opisthomelas* var. *minor* Hartlaub, 1867, Proc. Zool. Soc. Lond. (Pelew Islands).

SUBSPECIFIC CHARACTERS.—Similar to *Puffinus lherminieri polynesiae*, but with a shorter bill (shortest of the species).

TYPE.—Sex undetermined, McKean Island, in the Zoological Museum of Berlin.

RANGE.—Western equatorial Pacific, from the Phoenix to the Pelew Groups.

MEASUREMENTS (17 ♂ and ♀, including the type, from McKean, Canton, and Enderbury Islands, Phoenix Group, and from Ponapé, Nauru, "Carolines," and "Pelews." 56 adults measured for length of culmen).—Wing, 188–209 (202); tail, 73–84 (80.2); exposed culmen, 22.6–27 (26); depth of closed bill at base, 8.5–9.2; least depth of bill, 5.5–6; width of bill at base, 9–11.2; tarsus, 36–40 (38.2); middle toe with claw, 39–43 (40.8) mm.

The names *dichrous* and *minor* were published during the same year, 1867, and it is uncertain which has priority. The fact that *Puffinus dichrous* was accompanied by a detailed description, while *minor* is not even certainly applicable to a shearwater of this type, should, however, leave no doubt regarding the superior claims of the former name.

Through the courtesy of Dr. Irwin Stresemann, the writer has had an opportunity of examining the type, together with other specimens in the Berlin Museum from Nauru and the Pelews. These, as well as American Museum skins from the Caroline Islands, all seem to be identical with birds of a large series collected by Mr. J. G. Correia of the Whitney South Sea Expedition, at Canton and Enderbury Islands, Phoenix Group, on March 11 and 19, respectively, 1924. The latter were adults on their breeding grounds, with gonads in various stages of

enlargement. Many were molting the quills of wing and tail.

The colors of fleshy parts in life were as in other members of *therminieri*. Except for the remarkably short bill, the specimens resemble *P. l. polynesiæ*, although the dark plumage on the sides of the pectoral region in *dichrous* seems to be more broken on the average, scattered feathers sometimes mottling the breast almost to the mid-line.

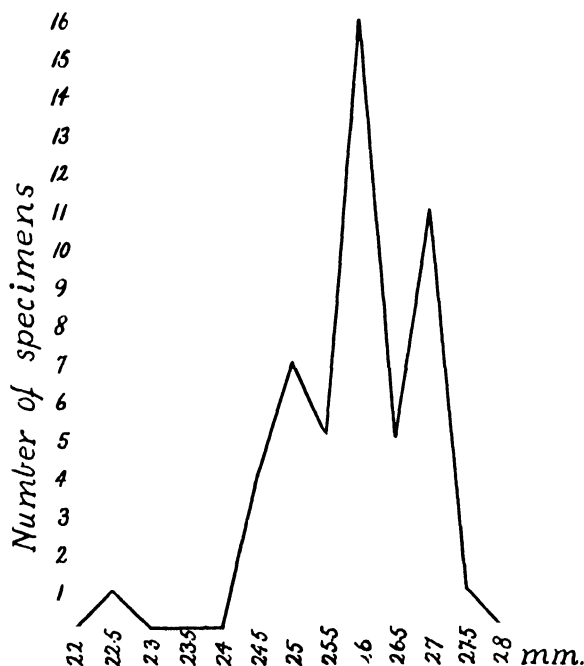


Fig. 1. Length of bill among 50 adults of both sexes of *Puffinus thermierii dichrous*, from the Phoenix Islands. Mean, 25.9 mm.

Among forty-nine specimens from the Phoenix Islands the bill length ranges between 24.5 and 27 mm. A fiftieth adult, however, has a culmen measuring only 22.6 mm., a sporadic variation of the type noted previously among examples of *P. l. thermierii*. Since range in dimensions has an important bearing upon critical systematic studies, the writer has prepared the accompanying graph which shows the frequency distribution of bill length among fifty specimens of this subspecies from a single insular group. The selected class range is 0.5 mm. Worthy of special note are the isolated individual just mentioned, and the fact that

the bill length in the largest group (16 individuals) falls on the line of the mean.

***Puffinus lherminieri nugax* Mathews**

Puffinus lherminieri nugax Mathews, 1912, 'Birds Austral.,' II, p. 72 (off Townsville, Queensland, Australia).

Mathews (*loc. cit.*, p. 60) quotes in full Solander's Latin diagnosis of a bird taken in lat. 19° S., long. "213° W.," on June 6, 1770. The colors, description of bill, large size (length, 1 foot; expanse of wings, 2 feet), and the locality all serve to link this reference with a specimen of a very distinct and striking shearwater recently sent from the field by the Whitney South Sea Expedition.

SUBSPECIFIC CHARACTERS.—A large, exceptionally dark-hued race of *Puffinus lherminieri*, with a long and slender bill, the dark feathers of the hind neck, back, secondary coverts, and lateral upper tail-coverts margined or tipped with white.

TYPE.—Non-existent.

REFERENCE SPECIMEN OR NEOTYPE.—No. 215393, Amer. Mus. Nat. Hist.; ♀ ad., ovaries enlarged; Melapav (= Meralav or Star Peak) Islet, Banks Group, New Hebrides Islands, Sept. 14, 1926; R. H. Beck.

DESCRIPTION.—Dorsal surface blackish brown, almost black on the pileum, the feathers of sides of neck and pectoral region broadly, those of hind neck, back, scapulars, and outer tail-coverts narrowly, margined with white; secondary-coverts tipped with white, those of the greater series broadly, forming a distinct bar; a faint fuscous bloom on the primary and secondary quills; lores and circumorbital region blackish brown, excepting a white streak on the lower eyelid only; dark feathers mingling with white along feathered cutting edge of mandible and continuing caudad, forming a mottled border across the cheek, upward into the post-aural region, and then downward to the sides of the breast; ventral surface, from chin to crissum, including the flanks, axillaries, and wing lining except along its anterior border, white; lower aspect of wing and tail quills dark neutral gray; under tail-coverts blackish brown, dark mouse gray, and white, some being one or the other, some particolored, the dark feathers being at least tipped with white. Iris, brown; bill, black, bluish on mandible and at base of culminicorn; feet and legs, flesh-color, the outer toe and outer side of tarsus, black.

MEASUREMENTS.—Length in the flesh, 350 (approx. 13.8 inches); extent of outstretched wings, 700 (approx. 27.6 inches); wing, 207; tail, 77; exposed culmen, 30.5; bill from gape, 43 (approx. 1.7 inches); depth of closed bill at base, 10; least depth of bill, 6; width of bill at base, 11; tarsus, 43; middle toe with claw, 45 mm.

***Puffinus lherminieri bannermani* Mathews and Iredale**

Puffinus bannermani Mathews and Iredale, 1915, Ibis, p. 594 (North Iwojima Island, Bonin Group).

SUBSPECIFIC CHARACTERS.—Similar to *Puffinus lherminieri nugax*, but with a decidedly stouter bill, much lighter dorsal coloration, especially on the head and nape which are grayish, and a white stripe above as well as below the eye.

RANGE.—Bonin Islands, Japan

MEASUREMENTS (9 adults, sex not recorded) Wing, 206-219 (212.6); tail, 74-81 (77.5); exposed culmen, 28-31 (29.5); depth of closed bill at base, 9-10; least depth of bill, 6.6-7.8; width of bill at base, 11-13; tarsus, 40-42 (41.3); middle toe with claw, 43-47 (44.9) mm.

This form is well described by Mathews and Iredale. Several of the nine American Museum specimens are paratypes, the labels bearing the data North Iwojima, Feb. 1910 and Oct., 1909, St. Dionisio, Jan., 1910, and "Bonin Islands," Apr. 1909.

The back of *P. l. bannermani* is of the unmistakable "brown black" hue which is characteristic of the whole species. But in this form alone the coloration of head and hind neck is distinctly lighter than that of back and wings. In fresh plumage the nape is close to dark gull gray, at least in certain lights. From shoulder to tail, the specimens resemble very closely our example of the New Hebrides race, but the heads of the two subspecies present a strong contrast. In *nugar* a rich, glossy brownish black plumage covers the pileum and hind neck solidly, not broken by even a superciliary stripe, and forming the darkest area on the body. The same area on *bannermani* is decidedly the lightest part of the dorsal aspect.

In both *nugar* and *bannermani* we encounter for the first time a whitish outlining or scalloping of the dorsal plumage which parallels the condition in one or more races of *assimilis*. The brownish tone, dark under tail-coverts, and dark primary quills, however, are as pronounced as in other forms of *therminieri*.

***Puffinus therminieri bailloni* (Bonaparte)**

Procellaria nugar, *a. bailloni* Bonaparte, 1857, 'Consp. Gen. Avium,' II, p. 205 (Mauritius).

Mathews (1912, p. 69) lists under *P. assimilis* two shearwaters from Réunion. A single skin in the American Museum from that island is, however, typical of the species *therminieri*. It is, moreover, indistinguishable from four taken at Aride and Cousine Islets, of the Seychelle Group, during February and March, 1908. For this reason the lot is classed under Bonaparte's name *bailloni*, and Mathews's somewhat ironic wish "that no one will name the Seychelle race without carefully examining series from both localities" is followed!

The writer has examined but six examples of this Indian Ocean form, which have proved insufficient as the basis of a satisfactory diagnosis. In size it appears to be closest to the Galapagos bird, although there is no other evidence of close kinship. In all dimensions except thickness of

bill it is smaller than the South Pacific race (*polynesia*). There is much white in the central part of the under tail-coverts, causing it to resemble the Cape Verde Island and West Indian birds. Its bill is almost as heavy as that of the latter form, although somewhat shorter. Very likely the closest affinities of *bailloni* are with the Atlantic subspecies, *P. l. lherminieri* and *P. l. boydi*.

MEASUREMENTS (5 ♂ and ♀ from the Seychelles, 1 from Réunion).—Wing, 187–200 (192.7); tail, 69–83 (74.2); exposed culmen, 27–28.5 (27.9); depth of closed bill at base, 9–10; least depth of bill, 6.8–7; width of bill at base, 11–12.6; tarsus, 37–40 (37.5); middle toe with claw, 39–42 (40.5) mm.

A NOTE ON DIMENSIONS AND PROPORTIONS

Mere statistics of measurements are difficult to grasp; and the smaller the dimensions, the harder it becomes to translate numerals into an accurate visual concept. It sounds like a very trifling distinction, for example, to say that the depth of bill in one race of *Puffinus* averages 0.5 mm. greater than in another. Yet, when specimens are laid out, the eye instantly seizes upon discrepancies of this magnitude and proceeds to make the most of them. Of such ranges are the comparative terms “bill decidedly heavier,” etc., which we find in this and other taxonomic papers. Such comparisons are useful and not misleading when based upon true means.

Proportions are often better criteria of differentiation than absolute measurements. Here again, however, their worth depends upon the representative quality of the material studied, for in a short series a single exceptional variation might greatly affect the mean. In the case of such small units as depth of bill, the error of measurement would be likely to be very high, but larger dimensions, such as length of bill, tail, etc., may advantageously be reduced to accurate proportions through the use of a slide rule.

Among the subspecies of *Puffinus assimilis* and *Puffinus lherminieri*, the length of bill seems to be relatively stable when compared with other structures. In the following table the average length of the exposed culmen is taken as unity, the means of the other dimensions appearing as multiples of the culmen. The values of the several figures are various, depending upon the number of specimens of each form, but as a whole they suggest certain definite proportional differences between the species *assimilis* and *lherminieri*, and also reveal the basis of comparative terms used in the preceding descriptions.

AVERAGE LENGTHS AND RATIO TO CULMEN

	Number of Specimens	Culmen	Tarsus	Mid-toe	Tail	Wing
<i>Puffinus assimilis assimilis</i>	2	24.5	35.5	41.5	63	172
" <i>kenadecensis</i>	15	26.1	39.6	44.3	65.5	190.5
" subsp.	1	29.5	39	46	69	199
" <i>munda</i>	6	25.8	40.3	47.1	66.8	190.5
" <i>godmani</i>	8	25.6	37.1	41.1	67.1	176.9
" <i>therminieri thermieri</i>	26	24.8	40.3	45.8	87.2	208.2
" <i>bophi</i>	4	26.2	37.5	42.5	76.5	173
" <i>colaris</i>	10	27.7	36	41.3	71.8	194.8
" <i>polyptera</i>	26	28.9	39.2	41.4	80.1	202.9
" <i>dichrois</i>	17	26	38.2	40.8	80.2	202
" <i>oagar</i>	1	30.5	43	45	77	207
" <i>bannermani</i>	9	29.5	41.3	44.9	77.5	212.6
" <i>bailloni</i>	6	27.9	37.5	40.5	74.2	192.7

cm for bill

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NOTES ON SOME ANTHIDIINE BEES OF MONTANA AND CALIFORNIA

BY HERBERT F. SCHWARZ

For the specimens on which the present paper is based and for valued data in connection therewith I am indebted to Professor R. A. Cooley, State Entomologist and Professor of Entomology at the University of Montana, who kindly sent me for identification the collection of Anthidiine bees in the possession of that institution, and to Professor P. H. Timberlake, of the Graduate School of Tropical Agriculture, University of California, whose careful observations upon the Anthidiine bees of Riverside, California, have furnished the clew to the merging of certain species hitherto believed to be distinct because each sex had been described under a separate specific name. Thanks are due also to Mr. S. A. Rohwer and Miss Grace Sandhouse of the U. S. National Museum for aid in arriving at some of the conclusions presented, and to Mr. E. T. Cresson of the Academy of Natural Sciences of Philadelphia for granting access to the types in that institution.

The types of the new varieties described in this paper have been deposited in The American Museum of Natural History; the paratypes, when such existed, have been returned to Professor Cooley.

So that the discussion might proceed by genera and also with a view to keeping distinct the insects from the two states considered, the California species, though constituting the smaller part of the material reviewed, have been given precedence over those from Montana.

***Anthidium edwardsii* Cresson, *tricuspidum* Provancher, *hesperium*
Swenk, and *depressum* Schwarz**

The recently described *A. depressum* is to be considered a variety of *A. edwardsii* Cresson rather than as an independent species. Re-examination of the type of *edwardsii* inclines me to the belief that it, too, is characterized by the deep triangular depression near the apex of the clypeus that I had believed peculiar to *depressum*. The clypeus of the type of *edwardsii* is unfortunately rather densely covered with foreign matter that obscures its shape, but by glancing along the contour line from below

it is possible to detect evidence of such a depression. There are feeble maculations in the type above the tegulae and on the femora (not mentioned in Cresson's description and unfortunately noted as absent in my recent key¹). *A. depressum* differs from *edwardsii* not only in the absence of maculations on the mesonotum, scutellum², and the femora beneath, and in the totally different character of the abdominal markings, but in the absence of red on the pygidium and other abdominal segments. Intermediate between *depressum* and *edwardsii* seems to be *tricuspidum* Provancher. I have not had a chance to examine the type of this species but several specimens identified as such in the collection of the U. S. National Museum agree structurally with *edwardsii* and *depressum* while evidencing degrees of intergrade between the abdominal markings established for *edwardsii* and those described for *tricuspidum*. The reddish pygidium and the strong suffusion with red of other segments of the abdomen, especially on the ventral side, characterize these insects as well as the type of *edwardsii*. In my estimation *tricuspidum* is a variety—and possibly a not very clearly separable variety—of *edwardsii* rather than an independent species.

Three males of *edwardsii* were recently sent me by Professor P. H. Timberlake. They were taken at Riverside, California; August 4 and August 14, 1925, visiting the flowers of *Trichostema lanceolatum*. With these males were sent me three females caught at the same flower on August 5 and August 6, 1925. These proved to be *A. hesperium* Swenk.

I am in accord with Professor Timberlake in believing that the males and females in question are one species. Strength is lent to this interpretation not only by the similarity of the two sexes, but by the records of distribution as recently reported by Professor Cockerell (Proc. Cal. Acad. Sci., Fourth Series, XIV, No. 15, pp. 346 and 354) for *A. hesperium* and *A. tricuspidum*. Thus three of the four localities in California where *hesperium* was taken proved also to be collecting grounds for *tricuspidum*, and vice versa.

A. edwardsii and its variety *tricuspidum* have hitherto been known only in the male sex; *hesperium* has been recorded only in the female sex. The name *edwardsii* having precedence, *hesperium* is to be considered a synonym of that species.

Two of the three females under consideration have L-shaped marks on the mesoscutum, like the specimens that I recently reported from Lindsay, California. The third specimen has, instead, the line over the

¹American Museum Novitates No. 253.

tegulae specified in Swenk's description. All three specimens have the first segment posteriorly emarginate instead of four spotted, agreeing in this respect with most of the insects examined by Cockerell in 1925.

A paragraph from a letter of Professor Timberlake, sent me in the course of our correspondence about the specimens, may be quoted here as adding interesting data to the life history of the *edwardsii* group:

The *tricuspidum-hesperium* (or *edwardsii*) species is two-brooded at Riverside, appearing at the end of May and again early in August. The first brood occurs on the flowers of *Phacelia ramosissima* and *Lotus glaber* and the second brood is very abundant in some years at the flowers of *Trichostema*.

Anthidium collectum Huard and **angelarum** Titus

To Professor Timberlake I am indebted also for the elucidation of another problem. Among certain Anthidiine bees that he recently sent me were the males and females of what he believed to be a single species. Both had been caught visiting the flowers of *Lotus glaber*. The females in question proved to be *A. angelarum* Titus; the males are what I believe to be *A. collectum* Huard. Fortunately, in this case too, reliance need not be placed solely on the rather close resemblance of one sex to the other and upon their visitation of the same flowers: the locality records also support the inference that they are one species. Thus, Titus based his description of *angelarum* largely on five females taken by Coquillett in Los Angeles Co., California, while in redescribing *collectum* he had before him five males taken by the same collector in the same locality. It may be mentioned, too, that the original description of *collectum* (given by Provancher under the name of *compactum*) was likewise based on a specimen taken by Coquillett in Los Angeles. The female of *collectum* has hitherto been unknown. In Titus' description of *angelarum* only the female is mentioned. I think there can be little doubt that the insects represent one species to which the name of *collectum* applies by virtue of priority.

Professor Timberlake's comments about this species (quoted from the same letter from which citation has previously been made) are of interest in this connection:

Angelarum (or *collectum*) was very abundant in the spring of 1925 at flowers of *Lotus glaber*, first appearing March 11 [the record in question is for Riverside, California]. In 1926 I found it on March 10 on *Phacelia distans*, but it was not nearly so common as during the preceding year. The season is much later this year and I have not yet seen it [the letter of Professor Timberlake is dated March 29, 1927]. *A. foetidis* [which in the female runs very close to "*angelarum*"] also occurs on *Lotus glaber* but this flies from May 22 to June 11 so far as my captures show. There is no question, I

believe, about the correct association of the sexes of the two species [*edwardsii* and *hesperium*; *collectum* and *angelarum*] that I sent you.

Timberlake does not mention the duration of the flight period of *collectum-angelarum* but, judging from the records cited by Cockerell and Titus, the adult insect is present in this locality or that over a fairly long period. Thus, males have been caught, according to these records, from May to July, and females from April to June.

***Anthidium porterae* Cockerell**

This species is represented in Montana by a male from Musselshell, August 16, 1917, and one from Billings, July 9, 1904. The insects were collected by K. M. King and R. A. Cooley.

***Anthidium tenuiflorae* Cockerell**

A large series of this species, collected from 1902 to 1926, is distributed among the following localities in Montana: Bozeman (elevation 4800 ft.), June 20–August 10; East Flathead (elevation 5700 ft.), July 25; Missoula, June 13–July 13; Armstead, July 11; Livingston, July 14; Billings, July 24; Gallatin County, July 19; Jefferson County, July 9; Lewistown, July 14; Pondera County, July 9–August 20. The specimens from Jefferson County and from Pondera County were collected by W. W. Stanley; most of the remaining specimens were taken by R. A. Cooley.

Two of the males—one from Billings and the other from Missoula—have two small maculations on the scutellum, suggestive of the condition in *emarginatum* though more restricted. A male from Bozeman, on the other hand, has one of the tubercles dotted with yellow, approaching *emarginatum* in this respect.

***Anthidium emarginatum* (Say)**

There is a single female of this species, taken at Huntley, Montana, July 23, 1917, by R. A. Cooley.

***Anthidium jocosum* Cresson**

A male taken by H. F. Dietz, July 4, 1912, at the Montana Experiment Station, Florence, is assigned to *jocosum* because of its light hue, reddish-brown pygidium and venter, the stripes on its tibiae, and the maculations on its tegulae and scutellum. Unlike the type, it lacks maculations on the apical segment and has the abdominal bands from segment

3 on rather more distinctly emarginate laterally than is indicated in the description of *jocosum*. The bands in question have a very slight interruption medially.

A female from Huntley, collected by R. A. Cooley, July 24, 1917, may possibly be the female of this insect. It is only slightly smaller ($6\frac{1}{2}$ mm.) than the rather small male ($7\frac{1}{2}$ mm.) above alluded to and has the general appearance of that male, notwithstanding its rather fuller maculation, which includes narrow L-shaped bands along the front and side margins of the mesoscutum (the mesoscutum of the male is immaculate) and maculations on its axillæ as well as the scutellum (confined to the scutellum in the male specimen), well-developed stripes on all the tibiæ, abbreviated apical stripes on the under side of the front and middle femora (the latter absent in the male specimen), and hind basitarsi (all of the basitarsi maculated in the male specimen). The band on the fourth segment of the abdomen is barely interrupted medianly, that on the fifth medianly emarginate, that on the sixth bisected by a very fine line of black. The bands from the third segment on to the apex are more shallowly and sinuously emarginate than in the male. There is a maculation on the clypeus between the lateral maculations, which, as noted in a previous paper, seems to occur not infrequently in females of the *jocosum* group, using that term in an inclusive sense, and the lateral face-marks do not completely fill the space between the clypeus and the inner margin of the eye, being placed slantingly along the sides of the clypeus as in the case of other females of this group.

***Anthidium utahense* Swenk**

A specimen from Yellowstone County, collected by H. C. Donohoe on June 28, 1926, has deep yellow markings and a faint maculation above the tegulæ, but its affiliations nevertheless seem to be with *utahense*.

***Anthidium brachyurum* Cockerell**

Six males—Missoula, July 5 16, 1904; Billings, July 9 24, 1924; and Huntley, July 19, 1917—have been assigned to this species rather than *utahense* because of the lighter shade of the maculations; but there is variability of hue even among these Montana specimens, making it very difficult to decide where the dividing line should be drawn, if indeed there be a dividing line, between *utahense* and *brachyurum*. One of four females assigned to *brachyurum* has a maculation between the lateral marks of the clypeus. The females are from the following localities: Missoula, June 29–July 26, 1904; Livingston, July 14, 1903; Boze-

man (elevation 4800 ft.), Aug. 16, 1901. With the exception of the specimen from Bozeman, which was caught by E. J. S. Moore, all of the insects were collected by R. A. Cooley.

***Dianthidium sayi* Cockerell**

This species is represented in Montana by specimens from the following localities: Billings, July 9–18, 1904; Musselshell, Aug. 16–20, 1917; Stevensville, Aug. 17, 1926; Yellowstone County, July 3–Aug. 8, 1926; Pondera County, Aug. 20, 1926; Jefferson County, Aug. 29, 1926. The insects were obtained by the following collectors: W. W. Stanley, K. M. King, J. R. Parker, H. C. Donohoe, and R. A. Cooley.

***Dianthidium pudicum* (Cresson)**

A male from Gallatin County, Montana, taken Aug. 23, 1917, is assignable to this species.

***Dianthidium parvum* (Cresson)**

A male of this species, caught Aug. 20, 1926, in Pondera County, Montana, by W. W. Stanley, has a line-like maculation in front of the anterior ocellus, recalling a similar maculation in the female of *parvum baculifrons* Cockerell. The abdominal maculations of this specimen, as well as the maculations behind the eye, are a deep uniform orange color, but there is suspicion that the depth of the coloration is due to cyanide.

***Dianthidium semiparvum gallatinæ*, new variety**

A male bee, collected August 23, 1917 in Gallatin County, is structurally too close to *semiparvum* to justify separation from that species, having the broad bulbous coxal spines that are among the characteristics of that insect, as distinguished from acute spines. Very exceptional among males of *Dianthidium*, however, it lacks maculations not only on the sixth but on the seventh segment of the abdomen, both of these segments being an undifferentiated black except for a narrow, deep-brownish, transparent border rimming the apex of the pygidium. As in *semiparvum* (and also *subparvum*) the scutellum is immaculate, but the legs show greater restriction of maculation than is evidenced by these bees. Thus, there is merely a narrow stripe, broadly flanked by black, on the front and middle tibiæ, while on the hind tibiæ there is only a basal and a much smaller apical maculation. Of the basitarsi only the hind pair are maculated, but the middle and hind knees have a yellow spot.

Two females—one from Gallatin County, the type locality of the male, but collected three weeks earlier, August 1, 1917, and a second taken at Bozeman on August 26, 1904—are referred to this subspecies.

They have the scutellum wholly black and, in addition, show restricted maculation of the abdomen. Thus, besides having segment 1 three-spotted and segment 6 immaculate, both of these specimens are four-spotted on segment 2 and in the case of one of them (the specimen from Gallatin County, which has been designated the allotype) this four-spotted condition applies also to segment 3. (In the case of the male there is a suggestion of subdivision in the bands of segment 2, approaching on one side at least the four-spotted condition.) The maculations of the legs are like those of *parrum*. From the female of *subparrum* the two members of that sex that are under consideration differ in the presence of spots on the anterior margin of the mesoscutum, and in the four-spotted condition of the second abdominal segment. The two females from Montana are rather different from the female described with some hesitation as the allotype of *semiparrum* and tend to confirm the doubts expressed at the time.

***Dianthidium ulkei* (Cresson) and *Dianthidium ulkei cooleyi*, new variety**

Among the nine specimens (all females) of *Dianthidium ulkei* from Montana are five which show a direction of variability that I do not find noted in the case of the fifty-three females and twenty-four males assigned to this species by Swenk. Nor do I find the condition paralleled among the specimens in the American Museum (thirty-one females and ten males). As the five specimens that share this peculiarity are all from Montana (four from the Montana Experiment Station at Musselshell and one from Billings) it would seem probable that a variety is in process of establishing itself. The remaining four specimens, also from Musselshell and taken like the preceding in August, 1917, are orthodox in their maculations if the term orthodox may be applied to a species as variable as *ulkei*; at any rate, these four seem to come within the limits of variability previously recognized.

Three of the five exceptional specimens have bright reddish-brown legs suggestive of the condition in *saga*, while in the other two the ground color of the legs is mainly black but with considerable encroachment of reddish brown. The yellow stripe on the tibiae are of variable length but not reduced to mere basal spots as in *parrum*, and all of the specimens save one have a well-defined vertical stripe below the middle ocellus, a condition at least unusual in *parrum*. Furthermore, all of the specimens have a subapical tooth on the mandibles, a condition which, as pointed out in a previous paper, may have diagnostic value. Reddish brown is present on at least the first sternite and in one instance on all of the sternites except the apical one. The specimen thus distinguished, which represents the extreme, has reddish brown instead of black on the first tergite and in the emarginations of the band on the second tergite.

It has been designated *Dianthidium ulkei cooleyi* in honor of Professor R. A. Cooley of the University of Montana. The specimens were all taken between July 30 and August 19, those from Musselshell being collected by K. M. King.

***Callanthidium formosum* (Cresson)**

This species, described from Colorado, and reported also from Oregon, extends into Montana, being represented by a male specimen from Bozeman, caught on July 15, 1904.

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A NEW *RAMPHOCORIXA* FROM HAITI (HEMIPTERA-CORIXIDÆ)

By H. B. HUNGERFORD¹

In view of the interesting relation between the North American *Ramphocorixa acuminata* (Uhler) and the crayfish upon which the female in fact places her eggs it is a pleasure to record a second species for this interesting genus. It would be of some biological importance to determine whether this second species has similar egg-laying habits.

Ramphocorixa rotundocephala, new species

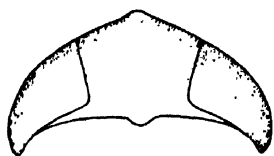
SIZE.—Length of male, 5.7 mm. Width of head, 1.75 mm.

COLOR.—General color pattern of this male is like that of many males of *Ramphocorixa acuminata* (Uhler) that show striping. The dark stripes are more densely pigmented in this specimen than in any *Ramphocorixa acuminata* (Uhler). Doubtless there is a tendency for the color pattern to be effaced and only the lack of a series makes it impossible to establish this point. The pigmented portion of the pronotum is restricted and margined by a brown line. Five dark cross-bands can be recognized. A large yellow field on the base of each clavus. Embolus white, distal half of clavus, and all of corium finely, longitudinally striped. The brown stripes, narrow and irregularly pectinate; five of them on corium. Membrane irrorated. Head, limbs and thorax, yellow. Sides of abdominal venter with shiny black bands arising on first abdominal segment and extending to tip of anal lobes. These bands broader on base of third segment, nearly meeting in the mid-ventral line.

STRUCTURAL CHARACTERISTICS. The head of the male is rounded as viewed from above, not keeled as in *Ramphocorixa acuminata* (Uhler). Frontal fovea broad and concave. Front two-fifths of vertex with a low, longitudinal median ridge beginning at apex of frontal fovea and ending abruptly before the middle. Pronotum short. Surface of pronotum and clavus rastrate. Front pala of male much like that of *Ramphocorixa acuminata* (Uhler). The deep cleft on the dorsal margin of the pala occurs nearer the base and the shape of the distal portion of the pala is less round. Twenty pegs are present in the stridular row on the type. Abdominal strigil minute. One oblique row about four times as long as broad. Pala and genital capsule as shown in the figures.

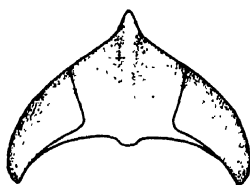
Described from a male collected by F. E. Watson at Manville, Haiti, Feb. 6-10, 1922, about 60 ft. altitude. Holotype property of The American Museum of Natural History. There are also two imperfect specimens of this species in the author's collection from Cuba.

¹Department of Entomology, University of Kansas, Lawrence, Kansas.



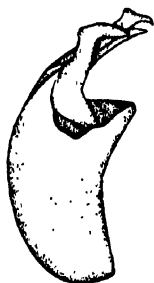
Ramphocorixa rotundocephala

1



Ramphocorixa acuminata (Uhler)

2



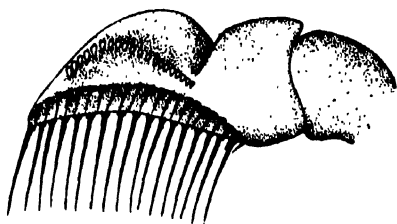
Ramphocorixa rotundocephala

3



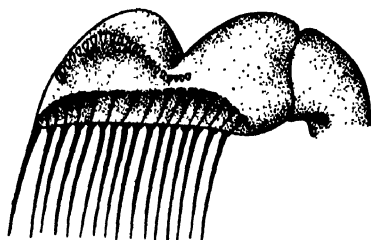
Ramphocorixa acuminata (Uhler)

4



Ramphocorixa rotundocephala

5



Ramphocorixa acuminata (Uhler)

6

Fig. 1. Dorsal view of head of male of *Ramphocorixa rotundocephala*.

Fig. 2. Dorsal view of head of male of *Ramphocorixa acuminata* (Uhler).

Fig. 3. Genital capsule of male of *Ramphocorixa rotundocephala*.

Fig. 4. Genital capsule of male of *Ramphocorixa acuminata* (Uhler)

Fig. 5. Pala of male of *Ramphocorixa rotundocephala*.

Fig. 6. Pala of male of *Ramphocorixa acuminata* (Uhler).

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A NEW TREE-FROG FROM PORTO RICO

BY KARL PATTERSON SCHMIDT

It is paradoxical to write of the most abundant species of tree-frog of Porto Rico as new to science, for this form is one of the best known in the genus, represented in many museums by large series of specimens. It is really famous, for its eggs and embryos were the basis for the article by Peters, describing the direct development, with suppression of the tadpole stage, which is a general character of the genus *Eleutherodactylus*. Peter's figures have found their way into great numbers of textbooks, usually under the original designation, *Hylodes martinicensis*.

The name now proposed for this well-known and well-characterized species is, nevertheless, the first to be based on Porto Rican specimens. The confusion of this form with other Antillean species has been due to the weight of authority that has identified it first with the Lesser Antillean *Eleutherodactylus martinicensis* (Tschudi) -- Peters, Gundlach, Garman, and Boettger -- and, later, with the Cuban *Eleutherodactylus auriculatus* (Cope) -- Boulenger, Stejneger, and Barbour. In dealing with this species in 1920, I accepted the identification with *auriculatus* without question.

Stejneger, in 1902, accepted Boulenger's record of *auriculatus* from Santo Domingo, and its occurrence on that island would of course make its presence in Porto Rico much more probable. The Nobles secured an allied species in the Dominican Republic, described by Dr. Noble as *Eleutherodactylus auriculatoides* (1923, Amer. Mus. Novitates, No. 61, p. 3) and it is probable that this species represents *auriculatus* in Santo Domingo.

The renewed and more intensive study of the Greater Antillean amphibian fauna was, to some extent, initiated by my field work in Porto Rico in 1919, which added six species of *Eleutherodactylus* to the supposedly well-known herpetological fauna of that island. This was followed by the work of Dr. and Mrs. G. K. Noble in the Dominican Republic in 1922, which added five new *Eleutherodactylus* and a new *Hyla* to the Hispaniolan fauna. The recent additions to the Cuban tree-frogs (eight species) and to the Jamaican fauna (six *Eleutherodactylus* and a *Hyla*) by the field work of Dr. Emmett R. Dunn in 1924 and 1925 were, consequently, scarcely surprising, though it may be emphasized that all

of these islands were supposed to be well explored herpetologically. The new crop of novel species was due to the application of a simple technique of collecting by voice at night, using an electric flashlight.

A better knowledge of the old species has inevitably accompanied the recognition of the new forms, and it is now evident that there are no native species of this genus generally distributed in the Greater Antilles. The Cuban *Eleutherodactylus auriculatus* is now well known through Dr. Dunn's field work. He writes me that this species does NOT breed in bromeliads, and that its cry resembles the syllables "chi-leén." The repeated "coqui" of the Porto Rican species, which gives it its native name, is one of the most characteristic sounds of the nocturnal chorus in Porto Rico.

All of this contributes little by little to the certainty that the common Porto Rican tree-frog is specifically distinct from any other West Indian form. It may be known as *Eleutherodactylus portoricensis*, new species.

***Eleutherodactylus portoricensis*, new species**

DIAGNOSIS.—An *Eleutherodactylus* of moderate size and stocky habitus; vomerine teeth in two short oblique series, behind the choanæ; nostrils near the tip of the snout; tympanum about half the diameter of the eye; disks of toes about equal to those of fingers, about three times as broad as the narrowest part of the corresponding phalanges; no trace of web; ventral disk faintly indicated; concealed parts of thighs immaculate, reddish in life.

TYPE.—A. M. N. H. No. 10249; ♂; El Yunque, 2000 feet altitude, Porto Rico; Karl P. Schmidt; September 30, 1919.

RANGE.—Generally distributed in Porto Rico, but confined to that island; apparently absent even on Vieques and Culebra, and certainly absent from Mona Island.

DESCRIPTION OF TYPE.—Head broader than body, its width slightly greater than the distance from tip of snout to the posterior border of the tympanum; nostril twice more distant from the eye than from tip to snout; diameter of eye equal to its distance from the nostril; tympanum nearly half the diameter of the eye, a little broader than its distance from the eye; heels broadly overlapping; heel reaching the eye when the limb is laid forward along the body; canthus rostralis rounded but well defined; lores sloping, slightly concave; disks of fingers subequal; disks of toes subequal, very little smaller than those of the fingers; first and second fingers equal in length; first and second toes subequal; skin finely rugose above, with a narrow median raised line, the general effect smooth; belly and thigh granulate; a fold across the chest; ventral disk faintly indicated by an impressed lateral line; vomerine teeth in straight, short, oblique series, their distance from the choanæ, in line with their outer borders, a little less than their length, the distance between them about half the length of one series.

Color dark brownish gray; a light canthal line over the edge of the eyelid, broadening over the tympanum into a dorsolateral light band, which merges into the

light belly color posteriorly; concealed surfaces of thighs and tibiae immaculate (reddish in life).

MEASUREMENTS OF TYPE.

Length of Body.....	36 mm.
Width of Head.....	15 mm.
Tip of Snout to Posterior Border of Tympanum.	11 mm.
Length of Arm.....	21 mm.
Length of Leg.....	52 mm.
Tibia.....	17 mm.
Tympanum.....	2 mm.
Eye.....	4.5 mm.
Largest Finger Disk.....	2 mm.

There are certain discrepancies between the above description and the detailed description given by Stejenger (1904, Rept. U. S. Nat. Mus., 1902, p. 585), but I am convinced that the two descriptions refer to the same species. Besides a high degree of variability in coloration, differences in preservation contribute to the difficulty of exact description of the species of this genus. It is notable that specific differences that escape laboratory examination are obvious in living material. Dr. Barbour writes me that he has independently reached the same conclusion concerning the specific distinctness of the Porto Rican and Cuban species.

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UNDESCRIBED OR LITTLE-KNOWN BIRDS FROM PANAMA

BY LUDLOW GRISCOM

After my return from western Panama in the spring of 1924, Mr. Rex R. Benson was left in the field to carry on a carefully planned series of expeditions aiming to cover all the remaining unknown or poorly known sections of the country west of the Isthmus. During the rainy season of that year Mr. Benson collected in the vicinity of Santiago, working southward to the coastal forest at the head of Monijo Gulf. These collections confirmed my impression that the heavy-forest species recorded by Arcé from "Santiago," a region where heavy forest never existed, did not occur there. In the late fall of 1924 and during the winter of 1925 Mr. Benson succeeded in reaching the continental divide in the mountains back of Santa Fé, securing over 1000 specimens from the cloud forest and the strip of heavy tropical forest at the base of the mountains. He more than doubled the number of interesting species obtained by Arcé sixty years ago. In addition to the forms described below, he added *Antrostomus rufus* to the known fauna of Veraguas, and obtained several tropical species like *Phanicothraupis fuscicauda*, previously unknown in western Panama, or unknown on the Pacific slope of the continent.

The summer of 1925 was spent in the interior of the Cape Mala peninsula, a mountainous region for the most part covered with heavy forest. Only a very faint tinge of the Subtropical Zone was found to exist. For the most part the avifauna here proved to be exactly the same as that of the coastal forests farther west. His most interesting discovery was a Ground-Dove connecting *Leptotila bathtyi*, a supposedly distinct species on Coiba Island, with the rare *Leptotila plumbeiceps* of eastern Central America.

The early fall was spent in the arid plains around Agua Dulce and in the nearby coastal swamps. Several water birds collected were previously unrecorded from Panama. Interesting discoveries of greater faunal and geographic interest were *Melopeleia asiatica*, the first definite record for the genus between northwestern Costa Rica and Ecuador, and *Falco fusco-caerulescens femoralis*, the first record for this species between Mexico and northern South America. A new race of *Dendroplex picirostris*

was found in the mangroves and a specimen of the very rare Goatsucker, *Stenopsis albicauda*, was collected.

The winter and early spring of 1926 were spent in an excessively difficult trip to the mountains back of Chitrá, a region much farther east than Santa Fé. All supplies and equipment had to be carried in on the backs of porters, the country being impassable for animals. The wind blew a gale, and it poured rain almost the entire time. His men deserted one by one, and Mr. Benson spent the last two weeks with one Panamanian boy, who was too frightened to find his way back to civilization alone. In spite of these handicaps Mr. Benson again doubled the number of interesting birds secured by Arcé. In addition to the long list of species and forms described below, he obtained *Oreopeleia costaricensis*, *Pharomachrus*, *Scytalopus chiriquensis* and *Pseliophorus luteoviridis*, discovered by me in the Cerro Flores country farther west, *Zelodonia*, *Diglossa* and all the Subtropical Zone genera and species ever recorded from western Panama east of the Volcan de Chiriqui, except *Oxyruncus* and *Cinclus*.

Mr. Benson was so exhausted after this trip that he was unable to take the field again for some time. During all this time he had been greatly aided by the aviators at France Field. Lieut. Dale V. Gaffney, a personal friend, had often brought him supplies and ammunition by airplane, with, of course, the kind co-operation of his chief, Lieut. Colonel Fisher, and the Museum is most appreciative of such invaluable assistance. In the summer of 1926 Benson and Gaffney organized a joint expedition to the Caribbean lowlands. Crossing the continent back of Santa Fé, they descended the mountains with twelve packers and collected at two camps on the Rio Calovevora, reaching an altitude of 800 ft. In addition to several novelties described below, they added *Cre-ciscus cinereiceps*, *Micromonacha lanceolata* and *Sporophila corvina* to Panama, and secured such birds as *Chloronerpes simplex*, *Dechonychura*, *Perissotriccus*, and other species notable either for great rarity, range extension, or both.

In all, the Veraguas collection now amounts to over 3100 specimens, and a total of 39 species and subspecies are described as new. Other forms, apparently new, await possible confirmation by the receipt of further material. The Rio Calevora collection was acquired largely through the generosity of Mr. Sanford Barnes. The balance of these collections were acquired by me, and donated to the American Museum.

***Odontophorus melanotis coloratus*, new subspecies**

SUBSPECIFIC CHARACTERS. Similar to typical *Odontophorus melanotis* Salvin of northeastern Costa Rica and eastern Nicaragua, but pileum much brighter rufous, the feathers lacking dusky tips; upperparts, wings, tail, flanks and under tail-coverts much darker brown, more sepia, less olive in ground color; underparts a richer and brighter chestnut, less brown; chin and throat of females devoid of any blackish or dusky wash.

TYPE.—No. 257,127, Amer. Mus. Nat. Hist.; ♀ ad.; Guaval, Rio Calovevera (alt. 1500 ft.), Caribbean rain forest of western Panama; Sept. 4, 1926; R. R. Benson and Lieut. Dale V. Gaffney.

SPECIMENS EXAMINED

Odontophorus melanotis melanotis. —NICARAGUA: 7 ♂, 7 ♀, from throughout the Caribbean slope

Odontophorus melanotis coloratus. —WESTERN PANAMA: Caribbean rain forest, 1 ♂, 1 ♀; Santa Fé, Veraguas, 1 ♂.

The three specimens listed above from western Panama merely confirm the stability of points of difference long since recorded by Salvin and more recently by Carriker. The typical form is a rather common bird for a partridge in the rain forest at lower altitudes. Many years ago Arcé sent a male from Veraguas to Salvin, though it could not have been taken at Santiago, where there is no heavy forest. The species has never been recorded since from Panama. Benson has recently obtained the three specimens listed above. The brightness of their crowns and their generally richer, deeper coloration agrees with Salvin's comments on Arcé's bird, and Carriker's description of a female from southeastern Costa Rica, which undoubtedly belongs to the form here described as new. Its characters are so marked that a specimen can be recognized immediately without comparison. The Santa Fé bird is, however, slightly darker above and a distinctly deeper, richer chestnut below even than the two specimens from the Caribbean slope. A series would probably show it to be separable as a third subspecies isolated in the tongue of rain forest which stretches westward along the base of the mountain on the Pacific side of the Continental divide.

Sex differences in this species do not seem to be definitely stated in text-books. In our females from Nicaragua, the throat is duskier, less black and is not so sharply demarcated from the chestnut of the breast. In females of *salvini* all traces of dusky are lost, and the throat is a slightly deeper chestnut than the breast. There are no differences in the freckling on the primaries and secondaries in my material.

Leptotila plumbeiceps malæ, new subspecies

SUBSPECIFIC CHARACTERS.—Exactly intermediate between *Leptotila p. plumbeiceps* (Sclater and Salvin) of eastern Central America and Colombia and *Leptotila battyi* Rothschild of Coiba Island, West Panama; upperparts much browner, less olive than typical *plumbeiceps*, with the purple gloss more pronounced over a greater area; throat and breast grayer, less vinaceous; flanks grayish brown rather than buffy olive-brown; differing from *battyi* in being browner, less chestnut above, the purple gloss less extensive; throat and breast more vinaceous, less gray; flanks grayer and paler, less brown.

TYPE.—No. 257,128, Amer. Mus. Nat. Hist.; ad. ♀; Cerro Montosa (2500 ft.), Cape Mala, western Panama; Aug. 2, 1925; Rex R. Benson.

SPECIMENS EXAMINED

Leptotila p. plumbeiceps.—GUATEMALA; Vera Paz, 1? NICARAGUA: Caribbean slope, 2♂, 1♀. COLOMBIA: various localities, 3♂, 3♀.

Leptotila plumbeiceps malæ.—WESTERN PANAMA: Cape Mala, 1♀.

Leptotila plumbeiceps battyi.—COIBA ISLAND, 1♂, 2♀.

The bird here described is of interest chiefly in connecting two Doves which have been hitherto properly regarded as very distinct species, and it is on this ground that I feel justified in basing the new form on one specimen only. Typical *Leptotila plumbeiceps* in Central America at least is a rare species of the darkest heaviest forest, and is unrecorded between Costa Rica and Colombia. Only in Costa Rica has it been found on the Pacific side of the continent. It is of great interest, therefore, to find a form of it on the Pacific side of Panama. The Cerro Montosa is in the very center of the Cape Mala Peninsula, nearly one hundred miles farther east than Coiba Island. The country is covered with heavy forest, but this territory is completely isolated from other forested areas in western Panama by the sea on three sides and savannahs and arid scrub-covered plains to the north.

Specimens are still lacking to confirm the probability that darker colored specimens of *Leptotila plumbeiceps* from southeast Mexico and Guatemala represent a typical race, and lighter birds from farther south a paler undescribed subspecies. Normally the upperparts are olive-brown, but darker colored specimens incline to bistre. The upperparts of *malæ* vary from Mars brown on the interscapulum and primary coverts to Prout's brown on the rump. The normal color of *Leptotila battyi* judging from our specimens and descriptions is uniform chestnut-brown. One specimen is not quite so bright, varying to auburn and cinnamon-brown on the rump, but the wing is distinctly brighter and more chestnut. It is obvious that *battyi* can no longer be maintained as specifically distinct.

THE GENUS *Premnoplex* IN CENTRAL AMERICA

As at present understood, *Premnoplex brunescens* (Selater) of Colombia and Ecuador is represented in Costa Rica and western Panama by the subspecies *brunneicauda* (Lawrence). The genus has never been recorded from eastern Panama, but a series in this collection from Mt. Tacarcuna represents a very distinct new form. A good series is now available from the mountains of Veraguas, and shows, as might be expected, that the bird there is easily separable from typical *brunneicauda*.

Premnoplex brunescens albescens, new subspecies

SUBSPECIFIC CHARACTERS.—Similar to typical *brunescens* (Selater) of Colombia and Ecuador, but paler, less rufous, more olivaceous above, the tail paler; much the palest race beneath, the ground color of the breast and abdomen less brown, more olivaceous; the throat and spots below pale ochraceous instead of deep buff or light buff, some of the spots on the abdomen almost whitish, practically lacking dark borders; tail longer than in any other race.

TYPE.—No. 135,863, Amer. Mus. Nat. Hist.; ♂ ad.; east slope of Mt. Tacarcuna, 4600 ft., eastern Panama; April 13, 1915; Anthony and Ball.

Premnoplex brunescens distinctus, new subspecies

SUBSPECIFIC CHARACTERS.—Upperparts about intermediate between *brunescens* of Colombia and *brunneicauda* of Costa Rica, the tail paler, as in the latter; buffy shaft streaks to the feathers on the forehead more conspicuous and better developed than in other races, often extending on to the crown; much darker below and richer buff on the throat than in *brunneicauda*; much nearer in these respects to *brunescens*, but more olivaceous, less brown; the dark borders to the light spots less conspicuous than in *brunescens*, thus resembling *brunneicauda* in this respect; size as in *brunneicauda*, larger than typical *brunescens*.

TYPE.—No. 257,134, Amer. Mus. Nat. Hist.; breeding ♂; Chitrá, 4000 ft., Pacific slope of Veraguas, western Panama; March 11, 1926; Rex R. Benson.

SPECIMENS EXAMINED

Premnoplex brunescens brunescens.—COLOMBIA and ECUADOR, 33 ♂, 14 ♀, 8 ♀.

Premnoplex brunescens albescens.—EASTERN PANAMA, 2 ♂, 3 ♀.

Premnoplex brunescens distinctus.—WESTERN PANAMA: Veraguas, Santa Fé, 3 ♂; Chitrá, 6 ♂, 8 ♀.

Premnoplex brunescens brunneicauda.—Mts. of COSTA RICA, 3 ♂, 4 ♀.

From the diagnoses given above, it may be inferred that the eastern Panama race, *albescens*, is sharply distinct from all its congeners in its paler underparts and longer tail. Passing northward to western Panama the race *distinctus* is nearer to typical *brunescens* than to *brunneicauda*, its nearest geographical ally. While combining the various characters separating these two races, in color it is distinctly nearer *brunescens* on the whole, though in size it is nearer *brunneicauda*. The synopsis below may assist in understanding the variations involved.

P. b. brunnescens.—Upperparts relatively darker and more rufous; tail darker; throat deep buff; underparts relatively darker and browner; shaft streaks on forehead relatively indistinct; wing, 59–64.5; tail, 54–61.

P. b. brunneicauda.—Upperparts relatively paler, less rufous, more olivaceous; tail lighter; throat light buff; underparts paler and more olivaceous; shaft streaks on forehead relatively indistinct; wing, 59.5–70; tail, 60–65.

P. b. distinctus.—Upperparts intermediate; tail lighter; throat deep buff; underparts intermediate, but much nearer *brunnescens*; shaft streaks on forehead relatively distinct; wing, 59–66; tail, 59.5–62.

P. b. albescens.—Upperparts much nearer *brunneicauda*; tail lighter; throat pale ochraceous; underparts paler, as in *brunneicauda*. spotting below paler and less distinctly bordered with darker than any other race; shaft streaks on forehead relatively indistinct; wing, 63.5–66; tail, 67–67.5.

***Dendroplex picirostris extimus*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to typical *Dendroplex picirostris* Lafresnaye of northern Colombia and Venezuela, but browner, less rufous above; much browner and duller below, no tinge of rufous in the plumage, abdomen dull Prout's brown rather than fox brown; even browner and less rufescent below than *longirostris* Richmond of Margarita Island, which is more chestnut above than the typical subspecies; pectoral spots slightly smaller than in both other races; size as in typical *picirostris*.

TYPE.—No. 257,131, Amer. Mus. Nat. Hist.; ♂ ad.; Agua Dulce, Prov. Coclé, western Panama; Sept. 2, 1925; Rex R. Benson.

SPECIMENS EXAMINED

Dendroplex picirostris picirostris.—41 specimens from the entire range, including a good series of topotypes.

Dendroplex picirostris longirostris.—MARGARITA ISLAND, 1 ♀.

Dendroplex picirostris extimus.—PANAMA: Darien, Cape Garachiné, 1 ♂; Juan Diaz, Canal Zone, 1 ♂; Coclé, Agua Dulce, 3 ♂, 2 ♀.

This genus was added to Central America by Hallinan (Auk, 1924, p. 319), but this account does not mention that the specimen observed was collected, as was the case. In all three Panama localities the bird has been on or near the coast, in scrub country on the edge of mangrove swamps, where it feeds regularly. The new race is so distinct that no further comment is required.

***Xiphocolaptes emigrans panamensis*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Xiphocolaptes emigrans costaricensis* Ridgway of the highlands of Costa Rica, but darker and more rufescent in coloration, both above and below, especially noticeable on the chest, belly and under tail-coverts, and the fore part of the wings; primaries tipped with sooty black instead of grayish brown.

TYPE.—No. 257,129, Amer. Mus. Nat. Hist.; ♂ ad.; Chitrá (3600 ft.), Veraguas (Pacific slope), western Panama; Jan. 23, 1926; Rex R. Benson.

SPECIMENS EXAMINED

Xiphocolaptes emigrans costaricensis.—COSTA RICA: Aquinires 1♂; Bonilla, 2♂, 1♀

Xiphocolaptes emigrans panamensis.—PANAMA: Chitrá, Veraguas, 1♂, 4♀.

Mr. Benson is to be congratulated on adding this fine genus of Woodhewers to Panama. In Costa Rica it is one of the very rare birds, and I know of only six specimens, besides the four listed above, previously unrecorded. Two of these are apparently immature, with browner pileums, the underparts broader with looser streaking and irregularly tinged with rufous. The new form is easily distinguished by its darker coloration, and is smaller, with a shorter tail than my *costaricensis*, but the size variation in this race is not known.

***Xiphorhynchus guttatus marginatus*, new subspecies**

SUBSPECIFIC CHARACTERS.—Most closely related to *Xiphorhynchus guttatus costaricensis* Ridgway of Costa Rica; identical in general coloration of upperparts, but wings averaging darker chestnut, the tips of the primaries always more extensively tipped with darker sooty brown; radically different underneath, the chin and throat brighter and deeper buff, the balance of the underparts a deeper shade; the chest more spotted, less striped, the spots heavily margined with black laterally, giving a more squamate effect; in this last character differing from *costaricensis* in the same respect as *X. g. rosenbergi* Bangs does from *X. g. nanus* Lawrence, but to a greater degree.

TYPE.—No. 187,328, Amer. Mus. Nat. Hist.; ♂ ad.; Santa Fé (1600 ft.), Veraguas (Pacific Slope), western Panama; March 16, 1925; Rex R. Benson

SPECIMENS EXAMINED

Xiphorhynchus guttatus nanus.—CANAL ZONE, 7♂, 2♀, 1? including the type. Eastern PANAMA, 5♂, 4♀. Northern COLOMBIA, 5♂, 2♀.

Xiphorhynchus guttatus costaricensis.—NICARAGUA, 2♂, 1♀. COSTA RICA: numerous localities, 11♂, 10♀.

Xiphorhynchus guttatus marginatus.—VERAGUAS: San Lorenzo River, 2♂, 1♀; Cape Mala Peninsula, 1♂, 5♀; Santa Fé, 6♂, 6♀, including the type; Chitrá, 1♂, 2♀.

The excellent series before me from so many localities emphasizes the wide individual variation in this species both in size and color. The upperparts are more or less tinged with rufous. The streaking on back and chest varies in extent. The coloration of the underparts can be slightly more olivaceous, more clay colored or even more tinged with raw umber, all found for instance, in the Canal Zone series. The race *costaricensis* appeared to be a very poor one at first sight, as browner specimens naturally appeared darker than more clay-colored variations of *nanus* from the Canal Zone. But with further study, browner specimens of *costaricensis* were a darker brown than the browner variations of

nanus, and the same way relatively with the other color variations. In fact there is only one specimen of *nanus* from eastern Panama which is as dark as the large series of *costaricensis*, which is a recognizable darker race. The Veraguas subspecies *marginatus* is far better characterized than *costaricensis*, however, and in no way connects it with *nanus*, although occupying an intermediate territory geographically. It occupies the lowland forests of the province on the Pacific slope, which are more or less isolated by savannahs and large areas of scrub forest from the habitats of the two adjacent races. It will be interesting to see to what race specimens from the Caribbean slope of Veraguas belong.

***Campylorhamphus borealis olivaceus*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Campylorhamphus b. borealis* Carriker of Costa Rica, but much darker above and below; the pileum black, the back deep umber-brown, shaft streaks on scapulars and primary coverts light rufous instead of buff, the tips of the primaries extensively sooty; underparts deep brownish olive instead of raw umber; shaft streaks on underparts broader.

TYPE.—No. 257,132, Amer. Mus. Nat. Hist.; ♀ ad.; Chitrá (3600 ft.), Veraguas (Pacific slope), western Panama; Jan. 3, 1926; Rex R. Benson.

SPECIMENS EXAMINED

Campylorhamphus p. pusillus.—10 ♂, 3 ♀, 1 ? from various localities in COLOMBIA and ECUADOR.

Campylorhamphus b. borealis.—COSTA RICA.—7 ♂, 1 ♀.

Campylorhamphus b. olivaceus.—VERAGUAS: Chitrá, 1 ♀; Río Calovevora, Caribbean slope, 1 ♀.

The form here proposed is so different from both *Campylorhamphus pusillus* and *C. borealis*, that problems of specific rather than racial distinction are raised. The obvious specific character of *pusillus* as compared with *trochilirostris* is its brownish and whitish rather than flesh-colored bill. The other color differences are racial characters in *pusillus*. Mr. Ridgway treated *borealis* as specifically distinct from *pusillus*, in that its bill was darker above, its general coloration was darker and more olivaceous, it was less streaked below, and not only widely separated geographically from *pusillus*, but part of the intervening territory (eastern Panama) was occupied by another species, *trochilirostris venezuelensis*. In general body coloration the degree of difference between the three is about the same. The bird here described complicates the question still further. Far from in any way serving to connect *pusillus* and *borealis*, it varies still farther away from *pusillus*, although geographically intermediate. Under these circumstances I prefer to regard *borealis* as specifically distinct from *pusillus*, and on this basis *olivaceus* becomes a well-marked subspecies of the former.

The specimen from the Rio Calovevora is even darker than the type, with narrower and more restricted shaft streaks both above and below. It is apparently another subspecies, but I prefer to await further material before describing it.

***Dendrocolaptes picumnus veraguensis*, new subspecies**

SUBSPECIFIC CHARACTERS.—Resembling *Dendrocolaptes picumnus costaricensis* Ridgway of Costa Rica in the relatively extensively barred lower breast and abdomen, but throat and chest more spotted, less streaked, the white shaft streaks to the feathers of the lower chest lacking; coloration both above and below strikingly tawnier, less grayish olive-brown; differing from the subspecies *seilerni* Hartert and Goodson of Santa Marta and northern Venezuela in exactly the same respects, but to an even greater degree.

TYPE.—No. 257,130, Amer. Mus. Nat. Hist.; ♂ ad.; Chitrá (4000 ft), Veraguas, west Panama; March 12, 1926; Rex R. Benson.

SPECIMENS EXAMINED

Dendrocolaptes picumnus seilerni.—VENEZUELA: Carabobo, 1 ♂, 1 ♀. COLOMBIA: Santa Marta Region, 4 ♂, 5 ♀, 1 ?.

Dendrocolaptes picumnus costaricensis.—COSTA RICA: La Hondura, 1 ♂, 1 ♀.

Dendrocolaptes picumnus veraguensis.—WESTERN PANAMA: Chitrá, Veraguas, 3 ♂, 1 ♀.

Very few specimens of this species have been taken in Central America, where it is a very rare bird of the Subtropical Zone, and the discovery of a well-marked new race in Veraguas is of some interest. One of our specimens was collected by Arcé many years ago and is brown and discolored with age.

***Pipromorpha oleaginea lutescens*, new subspecies**

SUBSPECIFIC CHARACTERS.—Connecting *Pipromorpha assimilis* with *P. oleaginea*; similar to *Pipromorpha assimilis dyscola* (Bangs) of Chiriqui and western Costa Rica, but olive-green of upperparts brighter and yellower, the upper tail coverts olive-ochraceous in distinct contrast with the olive-green of rump; edgings of remiges and rectrices broader, golden olive instead of olive-green; radically different below; chin grayish olive passing to yellowish olive on breast, and bright ochre-yellow on balance of underparts; similar also to *Pipromorpha oleaginea parca* (Bangs) of the Canal Zone, but less yellowish olive-green above, the upper tail-coverts less conspicuously ochraceous, the wing-coverts without buff tips; the yellow in the plumage devoid of any buff tint, and underparts a much brighter and clearer shade.

TYPE.—No. 187,459, Amer. Mus. Nat. Hist.; ♂ ad.; Santa Fé (2000 ft.), Veraguas (Pacific slope), western Panama; April 13, 1925; Rex R. Benson.

SPECIMENS EXAMINED

Pipromorpha oleaginea parca.—Large series (45) from eastern PANAMA and COLOMBIA.

Pipromorpha oleaginea lutescens.—PANAMA: Veraguas, Santa Fé, 10♂, 3♀; Chitrá, 2♂; interior of Cape Mala Peninsula, 2♂; 15 miles southeast of Santiago, 7♂, 3♀.

Pipromorpha oleaginea dyscola.—PANAMA: Chiriqui, Boqueron, 4♂, 1♀, 1? S. W. COSTA RICA, 7♂, 2♀.

This interesting discovery bridges the gap separating *Pipromorpha assimilis* and *P. oleaginea* and makes it necessary to regard *assimilis* and *dyscola* Bangs as races of *oleaginea*, the older name. The localities cited above extend east and west nearly 100 miles. Throughout the wooded portions of Veraguas *Pipromorpha* is a common flycatcher. Two specimens before me are not listed above. One is from the Cerro Flores in extreme eastern Chiriqui and the other is from the San Lorenzo River in extreme western Veraguas. These two specimens are exactly intermediate between topotypes of *dyscola* from western Chiriqui and topotypes of *lutescens* of Veraguas. In fact there is almost no limit to the intermediate races which could be carved out of this remarkably variable species. Birds from western Costa Rica are not typical *dyscola*, nor are specimens from eastern Costa Rica typical *assimilis*. In the Veraguas race *lutescens* the birds from Santa Fé and Chitrá in the interior at the base of the mountains are appreciably brighter than a series from the coastal forests.

***Empidonax flavescens floresæ*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to typical *Empidonax flavescens* Lawrence of Costa Rica, but upperparts darker and browner, the pileum and upper tail-coverts even browner, in distinct contrast to the back and rump; underparts more deeply and brightly colored, the yellow on throat spot and belly strontian yellow to lemon chrome; chest and sides of breast and throat deep olive-ochre, forming a broad breast band, enclosing the lighter throat spot and contrasted with the belly.

TYPE.—No. 182,830, Amer. Mus. Nat. Hist.; ♂ ad.; Cerro Flores (4000 ft.), extreme eastern Chiriqui, western Panama; March 8, 1924; Griscom, Boulton and others.

***Empidonax flavescens chitræ*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Empidonax flavescens floresæ* nobis described above, but not so brown above, the pileum and upper tail-coverts not so contrasted; in this respect intermediate between *flavescens* and *floresæ*, but distinctly darker than *flavescens*; underparts a duller, more waxy yellow than in *floresæ*, the throat spot darker and more inconspicuous, the chest band varying to light orange-citrine on the sides, blending more gradually into the yellow of the belly.

TYPE.—No. 257,135, Amer. Mus. Nat. Hist.; ♂ ad.; Chitrá (3600 ft.), Veraguas, Pacific slope of western Panama; March 3, 1926; Rex R. Benson.

SPECIMENS EXAMINED

Empidonax flavescens flavescens.—COSTA RICA: 12♂, 8♀, 1? PANAMA: Boquete, Chiriqui, 8♂.

Empidonax flavescens floresæ.—PANAMA: Cerro Flores, Chiriqui, 7♂, 3♀.

Empidonax flavescens chitræ.—PANAMA: Chitrá, Veraguas, 5♂, 7♀. A male from Santa Fé, Veraguas, is intermediate between *floresæ* and *chitræ*.

The large series of this species listed above from every section of its known range shows that it is readily distinguishable into three races. Veraguas specimens are separable at a glance from Costa Rican material by their brighter, deeper coloration and more conspicuous breast bands. The differences between the two eastern races are relatively slighter, but they are obvious in series, and *floresæ*, the geographical intermediate, is not intermediate in color characters. This species is one of the few really common birds in the lower levels of the Subtropical Zone. On the Cerro Flores it disappeared at about 5500 feet, just at the point where *Scytalopus* and *Myadestes* became common.

Mitrephanes aurantiiventris vividus, new subspecies

SUBSPECIFIC CHARACTERS.—Similar to typical *Mitrephanes aurantiiventris* (Lawrence) of Costa Rica, but general coloration brighter throughout; upperparts slightly greener, less olive, the pileum not darker, but the crest feathers blacker, thus producing a more contrasted effect; chin, throat and breast more cinnamon, less brown, the belly a deeper yellow, brighter and less buffy.

TYPE.—No. 257,136, Amer. Mus. Nat. Hist.; ♂ ad.; Chitrá (4000 ft.), Veraguas (Pacific slope) western Panama; Feb. 1, 1926; Rex R. Benson.

SPECIMENS EXAMINED

Mitrephanes aurantiiventris aurantiiventris.—COSTA RICA, 6♂, 3♀, from various localities in the mountains. PANAMA: Boquete, Chiriqui, 4♂.

Mitrephanes aurantiiventris vividus.—PANAMA: Chitrá, Veraguas, 4♂, 1♀.

The form here proposed is distinguishable at a glance from Costa Rican specimens, and is isolated in the Subtropical Zone of the high mountains of Veraguas. Specimens collected by Arcé at Calobre and Calovevora undoubtedly belong here also. The series from Chiriqui collected in 1901 is much browner above than fresh material from Costa Rica in the Dwight Collection, and would be instantly separable, were not this difference undoubtedly ascribable to post mortem change with age. The Veraguas race is a distinct approach to *Mitrephanes berlepschi eminulus* Nelson of eastern Darien in its brighter green back, and brighter yellow underparts, but not sufficiently so in my opinion to prevent their being maintained as distinct species. It is undoubted, however, that starting in Colombia there is a steady progression northward in this genus from green and yellow to brownish olive and russet.

***Heleodytes zonatus panamensis*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Heleodytes zonatus costaricensis* (Berlepsch) of the highlands of Costa Rica, but averaging smaller; the black center of the feathers on the pileum reduced in area; the hind neck with a buffier wash; belly and vent averaging slightly deeper ochraceous tawny, the under tail-coverts always spotted with black.

TYPE.—No. 187,573, Amer. Mus. Nat. Hist.; ♂ breeding; Santa Fé, Veraguas, Panama (alt. 2200 ft.); March 6, 1925; R. R. Benson.

SPECIMENS EXAMINED

Heleodytes zonatus costaricensis.—COSTA RICA: 9 ♂, 2 ♀ from various localities in the highlands.

Heleodytes zonatus panamensis.—PANAMA: Santa Fé, Veraguas, 4 ♂, 1 ♀

This species of Cactus Wren which has never before been recorded from Panama, was obtained by Mr. Benson in a locality where Arcé collected extensively. In spite of the wide gap in its range, the new form differs but little from *costaricensis*, in a combination of several slight average characters. The species is a remarkably stable one, as Nicaraguan birds do not differ from Mexican, the Costa Rican race is by no means well marked and, as pointed out by Dr. Chapman, West Ecuador birds are inseparable from *brevirostris* of Bogotá.

MEASUREMENTS

Heleodytes zonatus costaricensis, 9 ♂ wing, 72 –76.5 tail, 69 –73.5,
“ “ *panamensis*, 4 ♂ “ 68.5–72 “ 64.5–69.5

***Basileuterus bensoni*, new species**

SPECIFIC CHARACTERS.—Nearest *Basileuterus melanogenys* Baird of the mountains of Costa Rica and Chiriqui, but chestnut crown not so extensively bordered with black; upperparts iron gray instead of olive; underparts white instead of yellow, shaded with deep gray instead of olive; slightly smaller with a proportionately larger bill.

TYPE.—No. 257139, Amer. Mus. Nat. Hist.; ♂ ad.; Chitrá (4700 ft.), Veraguas, Pacific slope of western Panama; Feb. 26, 1926; Rex R. Benson.

DESCRIPTION OF TYPE.—Crown chestnut, margined very narrowly with black, these two lines converging in front, rendering the forehead black, some of the feathers tipped with white; sides of occiput and nape sooty black; upper back and wing-coverts deep iron or slate-gray, passing through “light dusky green-gray” to medium grayish olive on rump and upper tail-coverts; wings and tail dusky brown, edged with olive; a broad superciliary line of white; lores, orbital and auricular region black, flecked with white on the side of the neck, this color pattern extending across the chin; underparts white; sides of throat and chest, and a broad but vaguely defined breast band deep neutral gray, passing to deep grayish olive on the sides of the anal region; center of abdomen faintly tinged with very pale buff, passing to very pale clear buff on under tail-coverts; wing, 61; tail, 58; culmen, 10.5; tarsus, 22.

SPECIMENS EXAMINED

Basileuterus m. melanogenys.—Mts. of COSTA RICA, 8♂, 6♀. 1?

Basileuterus m. eximius.—Volcan de Chiriqui, PANAMA, 3♂.

Basileuterus bensoni.—Chitrá, Veraguas, 5♂, 3♀.

WING MEASUREMENTS

Basileuterus m. melanogenys.—8♂, 60.5–67

Basileuterus m. eximius.—3♂, 58–65.5

Basileuterus bensoni.—5♂, 55–63

On the basis of the three topotypes available, *Basileuterus melanogenys eximius* Nelson of the Volcan de Chiriqui is a recognizable race, differing in generally paler coloration, very slightly grayer olive above, markedly paler and whiter, less yellow below. It is in no sense an approach to the dark gray and white *Basileuterus bensoni* of the mountains back of Chitrá in extreme eastern Veraguas, a most interesting discovery of Mr. Benson's, and one which I am glad to name in his honor. His series was collected from 4000–5000 ft., the latter altitude representing the tops of the highest peaks. According to Carriker, *B. m. melanogenys* in Costa Rica is found from 6000 ft. to tree-line, and this difference in zonal range may perhaps account in part for the specific characters of its representative in Veraguas. I am permitted to add that the new species has been shown to Mr. W. E. Clyde Todd, now engaged in monographing the genus, and he agrees with me that its characters are specific and not racial. In this connection we must consider *Basileuterus melanogenys ignotus* Nelson, based on one specimen from Mt. Pirri in extreme eastern Panama. This bird is even greener and yellower than typical *melanogenys*, with a greenish yellow superciliary and most of the side of head greenish yellow instead of black. While the type is autoptically unknown to me, these very marked differences appear to me to be of specific value in this group. The relative degree of difference is much greater in this case than the characters separating *Basileuterus tacarcunae* from *B. tristriatus*. While the former lacks the black on the side of the head of the latter, it is geographically intermediate between undoubted races of *tristriatus*, certainly not the case with *B. melanogenys ignotus*. A binomial name, therefore, would very properly indicate the greater degree of difference of both birds.

***Basileuterus tristriatus chitrensis*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Basileuterus tristriatus melanotis* Lawrence of the mountains of Costa Rica, but underparts a duller and greener yellow, the breast and chest dirty grayish olive-green, instead of pale yellow, more or less tinged with greenish olive.

TYPE.—No. 257,138, Amer. Mus. Nat. Hist.; ♂ ad.; Chitrá (4000 ft.), Veraguas, Pacific slope of western Panama; Jan. 29, 1926. Rex R. Benson.

SPECIMENS EXAMINED

Basileuterus tristriatus melanotis.—COSTA RICA, 3♂. PANAMA: Chiriqui, 1♂.

Basileuterus tristriatus chitrensis.—PANAMA: Veraguas, Santa Fé, 2♂; Chitrá, 8♂, 7♀, 3?

The greenish gray shade underneath and the more heavily washed chest distinguish the new form at a glance, not only from *melanotis* of Costa Rica, but from all the South American races with black ear-coverts, in which the underparts vary from lemon chrome to amber and straw yellow. In the color of the underparts *chitrensis* resembles the distinct species *B. tacarcunæ* Chapman of eastern Panama.

***Basileuterus fulvicauda gaffneyi*, new subspecies**

SUBSPECIFIC CHARACTERS.—Nearest *Basileuterus fulvicauda toddi* nobis, and closely related also to *Basileuterus fulvicauda leucopygius* Slater and Salvin; ground color of underparts, basal portion of tail and tail-coverts about intermediate between these two; radically different from both, however, in having the chest, sides and flanks heavily washed and clouded with dark grayish olive; chin not so white as in either; supraloral streak as in *leucopygius*.

TYPE.—No. 257, 140, Amer. Mus. Nat. Hist.; ♂ ad.; Guaval, Rio Calovevora, humid tropical forest of Veraguas, Caribbean slope of Western Panama; Aug 22, 1926; Benson and Gaffney; named in honor of Lieutenant Dale V. Gaffney, an aviator at France Field, Canal Zone, who has rendered Mr. Benson invaluable assistance in his explorations, and who accompanied him as volunteer on his expedition across the continent to the Caribbean lowlands of Veraguas, collecting many of the rare and worthwhile specimens.

***Basileuterus fulvicauda toddi*, new subspecies**

SUBSPECIFIC CHARACTERS.—Nearest *Basileuterus fulvicauda leucopygius* Slater and Salvin of eastern Costa Rica and Nicaragua, but buff of tail-coverts and base of tail a deeper shade (clear buff rather than cream-buff); dark terminal portion of the tail occupying about one-half rather than two-thirds its total length; underparts deeper, more buffy, less white; suffusion of sides and flanks averaging browner, less grayish olive, the spotted appearance on the chest usually much less conspicuous; supraloral streak grayer, less buff.

TYPE.—No. 77,774, Amer. Mus. Nat. Hist.; Boqueron, Chiriqui, Pacific slope of western Panama; Oct. 11, 1901; J. H. Batty.

SPECIMENS EXAMINED

Basileuterus fulvicauda fulvicauda.—EASTERN ECUADOR, 4♂, 7♀.

Basileuterus fulvicauda semicervinus.—WEST ECUADOR AND COLOMBIA, 40♂ and ♀. EASTERN PANAMA, 9♂, 1♀, 2?; Canal Zone, 1♂, 1♀, 1?

Basileuterus fulvicauda toddi.—WESTERN PANAMA, Pacific slope: Veraguas, interior of Cape Mala Peninsula, 1♂, 1♀; San Lorenzo River, 1♂; Chiriqui, Boqueron, the type. S. W. COSTA RICA, 1♂, 2♀.

Basileuterus fulvicauda gaffneyi.—Veraguas, Caribbean slope, Rio Calovevora, 3♂.

Basileuterus fulvicauda leucopygius.—Eastern NICARAGUA, ♂♂, 3♀. Eastern COSTA RICA, 8♂.

When I collected this species in Veraguas, in 1924, it was apparent that I had a different form from that found in the Canal Zone eastwards. More material from representative localities in western Panama is now at hand, and with nearly 100 specimens before me, including topotypes, it is apparent that our conception of the Central American races of this species must be radically altered. In the first place, Chapman ('Birds of Ecuador,' p. 603) has already recorded the fact that eastern Panama specimens are inseparable from *Basileuterus fulvicauda semicervinus* of western Ecuador. In the second place, Sharpe's *veraguensis* proves to be a composite, and Mr. Ridgway very naturally followed him in his treatment of the species ('Birds of North and Middle America,' Vol. II pp. 756-758), never having seen an authentic specimen of *semicervinus*. Not only did Sharpe fail to discriminate the radical difference between the Veraguas and the Canal Zone specimens before him, but he overlooked radical differences between all Central American specimens north of the Canal Zone and various South American races, including the type of *semicervinus*. The type of *veraguensis* Sharpe is from Paraiso Station in the Canal Zone. Canal Zone specimens, however, are inseparable from *semicervinus* Selater of West Ecuador. Consequently, *veraguensis* must become a synonym of the latter. Other specimens cited by Sharpe in his original description ('Cat. Birds Brit Museum,' X, 1885, p. 403) from Veraguas and Chiriqui undoubtedly belong to the form described above as *toddi*, the characters of which are, however, radically different in many respects from those used by Sharpe to separate his *veraguensis* from *semicervinus*.

The West Ecuador race, *semicervinus* Selater, differs from all the Central American races in the following ten respects. The upperparts are more olive-green, less brown; the pileum is a clearer, less sooty gray, affording a marked contrast with the back; the underparts are uniform rich buff, only a little darker on the sides and flanks and approaching white on the center of the abdomen; there is no trace below of the dark suffusion, marbling and spotting with olive-brown (*toddi*), olive (*leucopygius*), or deep grayish olive (*gaffneyi*); the dark terminal band of the tail occupies only one-third of its total length; on the outer tail-feathers this dark area is greatly reduced, often represented by faint dusky marks only; the legs and feet are yellowish or pale horn, whereas they are much

darker in the Central American races; the lower mandible is almost always a lighter brown basally, instead of uniformly dark. .

So marked, therefore, are the differences separating *leucopygius* and the forms described above from *semicervinus* and typical *fulvicauda*, that it would be entirely permissible in my opinion to regard *leucopygius* as specifically distinct from *fulvicauda* and *semicervinus*, in which case *toddi* and *gaffneyi* would be races of *leucopygius*. In western Panama on the Pacific slope, intergradation between *toddi* and *semicervinus* is ecologically impossible. This bird is a heavy tropical forest species, and the forests of Veraguas are separated from the forests of the Canal Zone by the arid plains and scrubby savannahs of eastern and northern Veraguas and Coclé, where Pipits, Meadowlarks, Red-breasted Blackbirds and *Colinus* are characteristic members of the avifauna. However, this question raises the larger issues of what are specific rather than racial characters in the whole group, a matter entirely outside the purpose of the present paper. It may well be left to Mr. Todd of the Carnegie Museum, now monographing the genus, who has kindly urged me to describe the various new forms in western Panama in advance of his paper, and in a recent visit to this Museum, endorsed the subspecific validity of *gaffneyi*. It is a pleasure to name one of the new forms in his honor.

The characters separating *toddi* and *gaffneyi* from *leucopygius* require no further comment.

***Diglossa plumbea veraguensis*, new subspecies**

SUBSPECIFIC CHARACTERS.—Nearest typical *Diglossa plumbea* Cabanis of the mountains of Costa Rica; adult male differing only in that the blackish slate of the pileum and nape is distinctly demarcated from the deep bluish slate of the back; adult female radically different in being grayer olive both above and below, with a faint but distinct bluish cast above, especially on the wings; immature male in the first stage of plumage differing as does the adult female; in a later stage far more extensively and deeply tinged with cinnamon below, the under tail-coverts bright light cinnamon.

TYPE.—No. 257,137, Amer. Mus. Nat. Hist.; ♂ ad.; Chitrá (5000 ft.), Veraguas, Pacific slope of western Panama; Jan. 30, 1926; Rex R. Benson.

SPECIMENS EXAMINED

Diglossa plumbea plumbea.—Mts. of COSTA RICA, 14♂ ad., 5♂ imm., 5♀ ad.; Volcan de Chiriqui, 1♂ imm.

Diglossa plumbea veraguensis.—VERAGUAS, Chitrá, 2♂ ad., 2♂ imm., 1♀ ad.

This distinct new *Diglossa* is another of Mr. Benson's many interesting discoveries in the mountains of eastern Veraguas, and greatly extends the known range of the species. It was breeding at the time of his visit.

NOTES ON *Tanagra anneæ* (CASSIN)

A fine series of this species from the Rio Calovevora, Caribbean slope of Veraguas, western Panama, differs sufficiently from a series of topotypes from eastern Costa Rica to constitute a well-marked subspecies. Adult males have the yellow underparts strongly tinged with tawny orange, especially pronounced on the chest. Females are a distinctly deeper, slaty gray below; the sides and flanks not quite so yellowish olive-green; the crown less strongly tinged with tawny. In addition, the Panama birds are slightly smaller; the wing of seven males from Costa Rica, 63-68.5 (66.1); 10 females from Veraguas, 58.5-66 (62.2). The description of this new race is, however, inadvisable, due to nomenclatural difficulties. It happens that Salvin by a matter of months described *Euphonia rufivertex* from "Santiago," Veraguas (Pacific slope) as a synonym of *E. anneæ*. Two topotypes of *E. rufivertex* before me are exactly intermediate between Costa Rican and Rio Calovevora specimens. As *E. rufivertex* can never be definitely regarded, therefore, as identical subspecifically with *E. anneæ*, and as there is absolutely no room for an intermediate race, the more conservative course is to recognize the existence of a well-marked Veraguas race under the inappropriate name of *Tanagra anneæ rufivertex* (Salvin), topotypes of which will never exhibit the full development of the characters of the subspecies. A single male from the Volcan de Chiriqui is perhaps nearer typical *anneæ*. Incidentally, as a matter of precision, the type locality is erroneous. For many years Arcé made Santiago his headquarters, with various native collectors scouring the province for him. Many of the birds are labelled very generally "Santiago," and none of the heavy-forest species labelled "Santiago" ever occurred there, but were taken in the forest near the coast to the south or in the forest farther in the interior at the base of the mountains. In the case of the species here discussed, it occurs in western Panama on the Pacific slope only in the foothill forests of the mountains, where Arcé obtained it at three different points, and where Mr. Benson also met with it.

I can record one more fact concerning the geographical distribution and variations of this species. An adult male in the American Museum collection was captured at the base of Mt. Tacarcuna, in extreme eastern Panama, on March 14, 1915, by Anthony and Ball. This specimen resembles *T. anneæ rufivertex* in coloration, but is very large, the wing measuring 70 mm. When a series is assembled, the existence of a giant eastern race may be established. The white under tail-coverts and great extension of the tawny cap eliminate the possibility of a new form of *T*

xanthogastra, a race of which *chocoensis* (Hellmayr) is already known from eastern Panama.

***Chlorothraupis carmioli magnirostris*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to typical *Chlorothraupis carmioli* (Lawrence) of eastern Costa Rica, but slightly yellower on the chin and throat, less olive-green; size averaging slightly larger, with a much heavier bill, longer, deeper and wider.

TYPE.—No. 187,902, Amer. Mus. Nat. Hist.; ♀ ad.; Santa Fé (2000 ft.), Veraguas, western Panama; March 30, 1925; Rex R. Benson.

***Chlorothraupis carmioli lutescens*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar also to typical *Chlorothraupis carmioli*, but a much brighter yellow over the entire underparts, the chin almost gamboge yellow with but little green in it, the under tail-coverts also bright yellowish green; size about the same as in typical *carmioli*: the bill intermediate in proportions between *carmioli* and *magnirostris*.

TYPE.—No. 136,327, Amer. Mus. Nat. Hist.; ♂ ad.; Tacarcuna, eastern Panama; March 29, 1915; Wm. B. Richardson

SPECIMENS EXAMINED

Chlorothraupis carmioli carmioli.—Eastern NICARAGUA, 6♂, 5♀. Eastern COSTA RICA, 7♂, 6♀.

Chlorothraupis carmioli magnirostris.—Western PANAMA: Rio Calovevora, Caribbean slope of Veraguas, 8♂, 4♀; Santa Fé, Pacific slope of Veraguas, 2♂, 1♀.

Chlorothraupis carmioli lutescens.—Eastern PANAMA: base of Mt. Tacarcuna, 12♂, 6♀; Tapalisa, 3♂.

The excellent material listed above greatly increases the previously very limited range accredited to this species. It also shows that it is divisible into three readily recognizable races. It is of interest to note that it occurs on the Pacific slope at Santa Fé in Panama, in a strip of heavy forest at the base of the mountains which has long been known to harbor other species characteristic of the Caribbean slope, and which occur here only on the Pacific slope of western Panama. It is also of interest to record the fact that we have specimens of *Chlorothraupis olivaceus* (Cassin) from the lowland forest of eastern Panama. The existence of a new race of *carmioli* in eastern Panama was discovered independently by Dr. Chapman and me, and I here acknowledge gratefully his kindness in permitting me to describe it.

The series from Nicaragua is just perceptibly yellower below than a Costa Rican series, nowhere nearly enough so, however, to justify formal designation. As might be expected, the Santa Fé birds vary more from the typical form than do the Rio Calovevora specimens. These latter are distinctly intermediate in the development of the bill, but nearer

typical *magnirostris*. Figures do not give a very clear concept of the large size of this bill. In addition to the measurements given in the table below, I might add that in width at the nostrils the series of *magnirostris* averages at least a millimeter greater. The brighter and yellower underparts of *lutescens* distinguish it at a glance.

		MEASUREMENTS		
		Wing	Exposed Culmen	Depth of Bill at Nostrils
6 ♂	Nicaragua	85-89.5	16-17	8.8-9.2
7 ♂	Costa Rica	85.5-90.5 (87.7)	16-17 (16.4)	9-9.7 (9.1)
8 ♂	Rio Calovevora	87-94	16.5-17.5 (16.8)	9.8-10.5 (10.3)
2 ♂	Santa Fé	86-90 (90.0)	17.5-19 (18.2)	11 (11)
14 ♂	East Panama	86-95	16-17.5	8.8-10
5 ♀	Nicaragua	83.5-86	15.5-17	8.6-9.3
6 ♀	Costa Rica	85.5-90	16-17 (16.5)	9.2-10 (9.3)
4 ♀	Rio Calovevora	86-91.5	16.5-18 (17.3)	10-11 (10.5)
1 ♀	Santa Fé	88	19 (19.0)	11.5 (11.5)
7 ♀	East Panama	86-92.5	15.8-17.5	9.5-10

59.7, 58E(96.9)

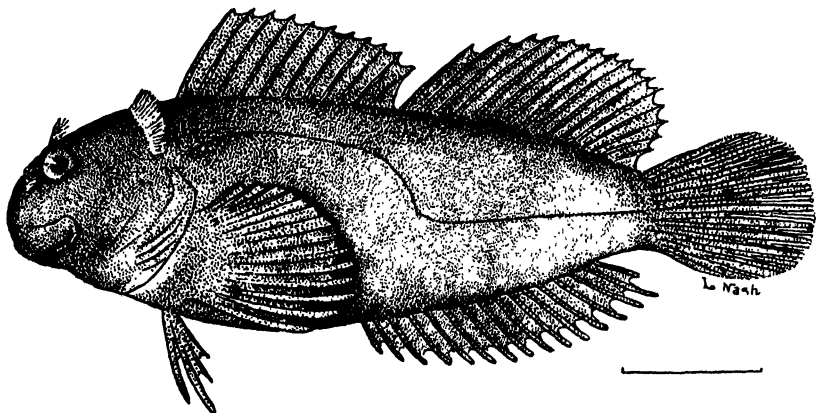
A NEW BLENNY FROM THE HAWAIIAN ISLANDS

BY N. A. BORODIN

Amongst fishes collected in 1923 by Major Chapman Grant at Oahu, a new blenny has been discovered. It belongs to the genus *Exallias* established by Jordan and Evermann in 1905, the type being *Salarias brevis* Kner. Only one species, *Exallias brevis* (Kner), was known previously. Fishes described by Günther as *Blennius brevipinnis* and by Day as *Salarias* and *Blennius leopardus* are synonymized with *Exallias brevis* (Kner) by Jordan and Evermann (see Jordan and Evermann, 'Fishes of the Hawaiian Islands.' Bulletin U.S. Fish Commission, 1903, XXIII, part 1, pp. 503-504).

***Exallias obscurus*, new species**

SPECIFIC CHARACTERS.—Body short (depth 3), slightly compressed. Head high (height $1\frac{1}{2}$ in its length), broad (breadth $1\frac{1}{2}$ in its length), $4\frac{1}{2}$ in the body. Eye

Fig. 1. *Exallias obscurus*, new species.

small ($4\frac{1}{4}$ in head; $2\frac{1}{2}$ in snout), situated almost in the middle of the upper surface of the head; cheeks swollen; mouth cleft large ($1\frac{1}{2}$ in head); branchiostegals present (4). The neck of the naked head is separated from the back by a groove in which a kind of fringed collar is situated. Lateral line makes a slight rising curve in

the beginning, then continues straight and in the middle of the body, makes a sharp, almost right-angled bend and then runs straight to the base of the caudal fin.

Color dark brown, almost black, with no spots.

D. XI, 16; A. 16.

DESCRIPTION OF THE TYPE.—Unique specimen, American Museum of Natural History No. 9363, 120 mm. long (standard), from Hawaiian Islands. Scaleless body short, only slightly compressed, greatest depth at middle of belly; head very high—its height only $1\frac{1}{8}$ in head length, and broad— $1\frac{1}{8}$ in length; cheek swollen; anterior profile beak-shaped, regularly rounded; mouth broad, its cleft $1\frac{1}{2}$ in head; snout blunt, lips both thick and provided with numerous small fleshy tubercles; eye high in about middle of the head; above eyes a fleshy flap provided with fringes, their length about half of eye's diameter; fringed tentacles surround nostrils; a very conspicuous fringed collar all around the neck. There are 4 branchiostegals. A conspicuous lateral line with two bends.

Color of alcoholic specimen dark brown, almost black all over the body, brown on the belly, and whitish along the central margin of the joined gill membranes, and on the isthmus. No spots or bands.

This new blenny can be easily recognized by its short and stout body, its plain dark color, its high fringed nuchal collar, small eyes situated near the middle of the head, and by the peculiar form of its lateral line.

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AN ORNITHOLOGICAL RECONNAISSANCE IN EASTERN PANAMA IN 1927

BY LUDLOW GRISCOM

With the collections from western Panama approaching approximate adequacy for the purpose of a distributional study of its avifauna, it became desirable to study conditions in eastern Panama with a view to planning a biological investigation of that little-known territory in the near future. I was fortunate in having my friend, Mr. Maunsell S. Crosby, accept my invitation to join Mrs. Griscom and me in a preliminary reconnaissance trip. He generously furnished the Museum with one-third of the necessary funds, subordinated his own wishes and interests in a most unselfish manner, and in the field was an ideal and enthusiastic companion. Mrs. Griscom voluntarily took entire charge of the photography. In Panama we were joined by Mr. Rex R. Benson, as a volunteer assistant, who collected with his usual enthusiasm and success. Mr. Paul F. Covel rendered efficient service as taxidermist. We were in the field from Feb. 9–March 13.

After a delightful visit with Dr. Chapman on Barro Colorado Island we sailed for the Pearl Islands on the yacht 'Big Bill,' which had been chartered for us through the kind offices of Mr. George S. Schaeffer of the Chase National Bank. We visited the majority of the larger islands of the group, collecting series of all the endemic birds, in addition to the Hummingbird described below. A special study of the great sea-bird rookeries was made, and Mrs. Griscom took 1700 feet of motion picture film and over 200 photographs. A full account of this phase of the expedition's activities will appear in another connection.

Crossing over to the mainland and entering the Gulf of San Miguel, we ascended the Sambú River to the upper limit of the tide. There was little point in collecting here, as this section had been thoroughly explored by Barbour and Brooks in 1922. This visit afforded me, however, the easiest method of examining the primeval tropical forest of Darien, which in density and luxuriance greatly surpasses the forest on the Pacific coast of western Panama, though exceeded in its turn by the rain forest in eastern Nicaragua and Costa Rica. The most fruitful country

visited was, however, the coast just back of Cape Garachiné. The whole coastal region of the Gulf of San Miguel is arid tropical, not humid tropical, and the forest is largely scrub, relieved by the gigantic "cuipo" tree (*Cavanillesia planifolia*). Anchored in the bay we could look inland (north) over the roofs of the wretched village of Garachiné to the heights of Mt. Sapo, and see the sharp cleavage on the lower slopes where the "cuipo" forest left off, and the heavy rain-forest began. Goldman, indeed ('Mammals of Panama'), reports that this arid tropical forest invades the interior in places, occurring even on the upper reaches of the Rio Tuyra. It is apparent, therefore, that some other factor besides rainfall and altitude is effective in controlling its distribution. It also became obvious that the area shown on Goldman's map as arid tropical is by no means so extensive or so uniform as indicated. Thus it does not occur on the Sambú River above tidewater. The matter is of considerable biological importance, as the avifauna of the arid and humid tropical forests in this region is totally different.

With a view to obtaining further light on this question, we visited Chiman, some fifty miles farther up the coast towards Panama City, where several days were spent in scouring the country in every direction. Except for clearings, this country was covered with unbroken humid forest and there was not a trace of the scrub forest of Cape Garachiné or of its avifauna. Birds were surprisingly scarce, but such indicator species as were collected all belonged to the South American element, which consequently occurs much farther west than previously recorded. A clear morning permitted an excellent view of the mountains in the utterly unknown interior, between the headwaters of the Bayano and Chucunaque Rivers. Their altitude greatly surpasses that of Mt. Sapo (3700 feet), and Benson and I vowed that some day we would have birds from their upper slopes.

The following annotated list mentions all species of importance, in addition to the novelties. One or two sight records are included of birds easy to recognize, with which Benson or I had had previous experience. At the present writing I know of 942 species and subspecies for which I have a record in the Republic of Panama. Of these I have examined specimens of 922, and I have seen over 550 in life. As Goldman pointed out in his 'Mamma's of Panama,' the avifauna of eastern Panama seems to be inexhaustible. During our brief visit, Mr. Crosby and I encountered over 250 species, and over 150 were collected. We kept a daily bird-list and journal. With no effort to "make a list," on several occasions more than 75 species were observed or collected in a day.

ANNOTATED LIST OF NOTABLE SPECIES

1. *Stercorarius pomarinus* (Temminck). Pomarine Jaeger.— Several seen in Colon Harbor on March 13.
2. *Stercorarius parasiticus* (Linnæus). Parasitic Jaeger.— One in Colon Harbor, Feb. 9, and eight birds, either this species or the next, on March 13.
3. *Stercorarius longicaudus* Vieillot. Long-tailed Jaeger.—One off the docks at Colon, Feb. 9. No Jaeger has been recorded to my knowledge from Panama waters. It was consequently a great surprise to find these birds abandoning their pelagic habits in their winter quarters and following steamers into Colon Harbor, where they squabbled with the Laughing Gulls for refuse, as tame and fearless as are Herring Gulls in northern waters. The two smaller species were on occasion so close that the number of primaries showing white shafts could be counted accurately. On March 13 both Benson and Lieut. Gaffney were with us, and these birds were pointed out during a motor-boat trip across the harbor. They will make every effort to secure specimens.
4. *Catoptrophorus semipalmatus inornatus* (Brewster). Western Willet.—No form of the Willet has been definitely recorded from Panama, and Hallinan (1924, Auk, p. 309) was the first to record the species, a fact of which he was unaware. His three specimens from Juan Diaz are this race. There could be no better illustration of the accidents of collecting. As a matter of fact the Willet is one of the commonest shore-birds on the great flats at the mouths of the rivers on the Pacific Coast. The tide-fall being from 7-14 feet, these rivers have exposed mud-banks ten miles or more from their mouths, and the Willet and Curlew go way up these rivers, roosting in the mangroves at high tide. Specimens shot by us at Garachiné and Chiman all belonged to the western race.
5. *Ereunetes mauri* Cabanis. Western Sandpiper.—All specimens of this genus collected were the more western species, which has only once been recorded definitely from the Republic, although undoubtedly abundant.
6. *Agamia agami* (Gmelin).—This beautiful Heron is sufficiently rare in Central America to make it worth while to record all additional observations. Two adults were seen in the great swamps at the mouth of the Sambú River on Feb. 24, and another adult at Chiman, March 6.
7. *Tigrisoma cabanisi* Heine.—This Tiger Bittern has long been known to range southward to the Canal Zone. It has recently been recorded from the Pearl Islands, and we saw an adult at Chiman on March 7.
8. *Sula dactylatra* Lesson.—The big white Booby is sometimes not uncommon off Colon Harbor just outside the breakwater. On Feb. 13, 1924, I saw no less than 30. On Feb. 9, 1927, we saw four adults.
9. *Sula piscator* (Linnæus).—The Red-footed Booby also occasionally wanders into Colon Harbor. Two adults were noted by Mr. Crosby and me on Feb. 9. It is easily distinguishable at great distances from the last species by its smaller size and proportionately longer tail.
10. *Sula leucogastra* (Boddaert).—One seen sitting on the breakwater of Colon Harbor, Feb. 9. No Booby has been recorded from the Caribbean side of Panama to date, but there is no reason why these three species should not be of regular occurrence off the coast.

11. *Buteo swainsoni* Bonaparte. Swainson's Hawk.—Bangs and Barbour (1922, Bull. Mus. Comp. Zool., XLV, p. 192) have recorded 2 great hawk flights in April, 1922, observed by the latter in eastern Panama, which were undoubtedly composed of this species. On March 6, 1927, we observed a flock of 22 Swainson's Hawks drifting westward. In the late P.M. of March 7 an enormous flock of at least 1000 came up from the east in three main detachments. These were at a great altitude, and were wheeling in a great cloud, which gradually drifted westward. On the morning of March 8 a flock of 820 passed overhead with similar evolutions. Almost all the phases of this species were represented in these gatherings. With them were a few Broad-winged Hawks. Such habits on migration as these account very naturally for the great rarity of specimens from Central America.

12. *Ara ambigua* subspecies.—About three pairs of the giant Green Macaws lived in the hills of Cape Garachiné, where we saw them daily. They inhabited the tops of the very tallest "cuipo" trees, were wise and wild, and could have been killed only with a lucky rifle shot. This species has never been recorded from eastern Panama, but the absence of specimens in this case means absolutely nothing.

13. *Momotus subrufescens reconditus* Nelson.—Collected both at Cape Garachiné and at Chiman, the latter record greatly extending the range of this subspecies to the westward. In the vicinity of Panama City the subspecies *conexus* Thayer and Bangs is not uncommon in thickets and patches of scrub forest. It apparently skips the heavier forests of eastern Panama, where it is represented by *reconditus*, to reappear in the Magdalena Valley of Colombia, where it is intermediate in color characters between the darker *reconditus* and the paler *subrufescens* of a more arid climate and habitat.

14. *Antrostomus rufus rufus* (Boddaert).—Two of these birds were flushed in an open thicket at Cape Garachiné. One lit in full view on a log at close range. In the excitement of the moment I forgot to adjust my collecting pistol, and fired a small charge of dust-shot from the .22 aux barrel instead of a heavy .32 shell in the lower barrel. The inevitable result was that I merely tickled the bird into a rapid and complete departure. In life the male looks like a ruddy Chuck-wills-widow. There are very few records for this species in Panama. These, however, indicate clearly that it is not a forest species.

15. *Panyptila cayanaensis* (Gmelin).—A single Forktailed Swift was seen with small *Chaturx* at Cape Garachiné on Feb. 25. As with the Green Macaw, the scarcity of records for Panama means nothing with a species which can be collected only by lucky accident.

16. *Saucerottia edwardi margaritarum*, new subspecies

SUBSPECIFIC CHARACTERS.—Similar to typical *Saucerottia edwardi* (Delattre and Bourcier) of the vicinity of Panama City, but lower back much less coppery more greenish bronze; tail also much less coppery more greenish bronze, the reddish violet tinge often lacking altogether, or present only on the central pair of feathers and the tips of the others; under tail-coverts light chestnut, margined with whitish, instead of dusky tinged more or less strongly with rufescent; flanks often tinged distally with light chestnut.

TYPE.—No. 257,141, Amer. Mus. Nat. Hist.; ♀ ad.; Pedro Gonzales Island, Pearl Islands, Panama Bay; Feb. 18, 1927; Griscom, Crosby, *et al.*

17. *Saucerottia edwardi crosbyi*, new subspecies

SUBSPECIFIC CHARACTERS.—Similar also to typical *Saucerottia edwardi* and the form characterized above; lower back more coppery bronze, in this respect nearer *edwardi*; tail quite different from either, solid golden bronze, in only 1 specimen a tinge of coppery on the tips of the central tail-feathers; in all but one specimen all but the central pair of tail-feathers are tipped with light chestnut-brown; flanks and under tail-coverts as in *margaritarum*.

TYPE.—No. 257,142, Amer. Mus. Nat. Hist.; ♂ ad.; Cape Garachiné, eastern Panama; March 5, 1927; Griscom, Crosby, *et al.* Named in honor of Maunsell Schieffelin Crosby, friend and choice companion, who assisted in financing my 1927 expedition to eastern Panama, and collected most of the specimens of this new Hummer at my special request.

SPECIMENS EXAMINED

Saucerottia e. edwardi.—PANAMA: Canal Zone, 6♂, 1♀; La Chorrera, 2♂.

Saucerottia e. margaritarum.—PEARL ISLANDS: Pedro Gonzales, 1♀; El Rey, 7♂, 4♀; Saboga, 1♂, 1♀.

Saucerottia e. crosbyi.—EASTERN PANAMA: Capeti River, 1?; Cape Garachiné, 4♂, 1♀.

Saucerottia edwardi, so far as known, has a very limited range. It is common in the open scrub and savannah country in the neighborhood of Panama City, and does not occur on the Caribbean side of the Canal Zone, the chief reason why relatively few specimens of it exist in collections in this country. Brown found it common on the Pearl Islands some years ago, and collected a good series, now in the Museum of Comparative Zoology, which Mr. Outram Bangs has kindly loaned me. At the time they were received, Mr. Bangs apparently possessed only one normally colored specimen of the typical form. When series are compared, however, the Pearl Island bird is obviously distinct, and one of the best marked of the several local races found there. The species has never been recorded in eastern Darien, and I was greatly surprised to find it common in the remarkable "cuipo" tree forest at Cape Garachiné, feeding for the most part quite out of shot gun range. A specimen collected by chance the first day seemed to me decidedly different from the species as I knew it, and Mr. Crosby finally succeeded in securing additional material. In most parts of eastern Panama, rain-forest reaches the coast, so that the Cape Garachiné and Rio Capeti stock is certainly isolated from the Panama City form. In characters the new race *crosbyi* differs just as trenchantly from *edwardi* as does the distinct species *niveoventer* (Gould) of western Panama and Costa Rica. The copper bronze tail of *edwardi* is exactly half-way between the violet tail of *niveoventer* and the golden tail of *crosbyi*. However, *margaritarum* is a distinct link between *edwardi* and *crosbyi*, and no such link is known be-

tween *edwardi* and *niveoventer*. A good series of *niveoventer*, collected by Benson and me in various parts of Veraguas, does not differ in the east from topotypical material from western Chiriqui and consequently does not in any way approach *S. edwardi*. I prefer, therefore, to maintain these two as distinct species, and divide the latter into what I regard as three very distinct forms.

Returning to *crosbyi* for a moment I note that the Rio Capeti specimen lacks chestnut tips to the tail-feathers and all the Garachiné specimens possess them.

18. *Chlorostilbon assimilis* Lawrence.—A breeding male collected at Cape Garachiné on March 3 is indistinguishable from Canal Zone specimens. Just like *Saucerottia*, the range of this species is considerably extended eastward.

19. *Monasa pallescens minor* Nelson.—Collected at Chiman, thus considerably extending its range westward.

20. *Chrysophilus punctigula striatigularis* Chapman.—One collected in a dense red mangrove swamp at Garachiné, Feb. 27, and another seen at a time when Mr. Crosby and I were struggling helplessly in a maze of huge roots over a sea of mud. Not only is this bird new to Panama, but it also adds another South American genus to the avifauna of Central America.

21. *Taraba major transandeanus* (Sclater).—So far as I know, this large Ant Shrike has never been recorded between the Canal Zone and Colombia. Two specimens were collected by Benson at Garachiné, and we have others from the Rio Tuyra. In eastern Panama it is an arid tropical species, and does not occur in heavy forest.

22. *Thamnophilus nigriceps* Sclater.—This species was only recently recorded from Panama (Chapman, 'Birds of Colombia,' 1917, p. 365). We found it abundant in the thorny thickets at Cape Garachiné.

23. *Herpsilochmus rufmarginatus exiguus* Nelson.—This little Ant Wren is known only from the two specimens collected by Goldman in eastern Panama. I collected one out of a flock of three at Cape Garachiné, and saw another later with a flock of Warblers. In both cases the birds were in the tops of tall trees, practically out of gun-shot range.

24. *Myrmeciza exsul exsul* Sclater.—Abundant at Chiman, a slight eastward extension of its range.

25. *Myrmeciza maculifer cassini* (Ridgway).—Common in the darkest, heaviest forest on the Sambú River. Field experience with this species and both races of *exsul* convinces me that Dr. Hellmayr errs in regarding them as representative forms. In haunts, notes and song, the two birds are radically different, and there is no evidence of intergradation.

26. *Xenerpestes minlosi* Berlepsch.—One specimen only of this excessively rare genus has been taken in eastern Panama (at Tacarcuna by Anthony and Ball of this Museum) (cf. Hellmayr, 'Cat. of Birds of the Americas,' part 4, p. 167). Crosby and Benson collected two specimens on the Sambú River. These two birds were with a flock of Warblers, small Tanagers and Honey Creepers in a small flowering tree on the edge of an Indian clearing, and were acting and feeding just like Warblers. It is difficult to believe that this genus is correctly allocated in the Furnariidæ.

27. *Sclerurus guatemalensis salvini* Salvadori and Festa.—Throughout Central America at least this species is found only in heavy forest. I was accordingly agreeably surprised to collect a specimen strolling on the ground in an open thicket at Cape Garachiné. This specimen proves to belong to the West Ecuador race. Birds from the heavy forest in the interior are typical *guatemalensis* (cf. Chapman, 'Birds of Ecuador,' p. 453). The division between the two races is apparently an ecological one.

28. *Microtriccus brunneicapillus* subspecies.—One collected by Benson at Chiman, March 7. Previously known in Panama only from the Canal Zone. This specimen and others from Colombia and Ecuador do not quite agree with the types from the Canal Zone, but they also do not quite agree with each other. What is needed is a fresh series from the type locality, before the variations in this rare species can be properly appreciated.

29. *Elainaea gaimardii macilvainii* Lawrence.—One collected at Cape Garachiné. The reputed rarity of this bird in Panama is probably due to its being practically impossible to separate this species in the field from *Myiopagis*. Dr. Hellmayr is certainly well advised to suppress the genus *Elainopsis*.

30. *Sublegatus modestus glaber* Selater and Salvin.—Dr. Hellmayr has left the status of Panama specimens of this genus uncertain ('Catalogue of Birds of the Americas,' part 4, p. 448, footnote). Such specimens as I have examined agree minutely with a large series of the race *glaber*. The bird ranges west through the arid scrub country of western Panama, where, however, it is quite rare. I have specimens from Santiago, Veraguas, and Agua Dulce in Coclé. The Dwight Collection contains a series of the very rare *Sublegatus arenarum* from western Costa Rica. This bird is quite distinct from *glaber*.

31. *Pipra erythrocephala actinosa* Bangs and Barbour.—This South American species was common at Chiman. Specimens were collected to establish the extension of range westward. It will be interesting to determine what factors keep this species and *mentalis* apart in Panama, and where the boundary between the two birds is.

32. *Neochelidon tibialis* (Cassin).—This dull-colored little Swallow is apparently very local, and in Central America has been recorded only from the Isthmus. Two or three pairs were found on the Sambú River nesting in holes in the river bank, directly under Indian huts. They were remarkably tame and confiding, and as they never left the radius of the clearing, collecting one was not deemed to be expedient.

33. *Riparia riparia* (Linnæus). Bank Swallow.—A flock of ten migrating westward on March 8 about a mile off-shore from Cape Garachiné. There are surprisingly few records for this species in Central America.

34. *Lanivireo flavifrons* (Vieillot). Yellow-throated Vireo.—One collected at Garachiné, March 4. There are very few records for the Yellow-throated Vireo south of western Panama.

35. *Pachysylvia minor darienensis*, new subspecies

SUBSPECIFIC CHARACTERS.—Similar to typical *Pachysylvia minor* (Berlepsch and Taczanowski) of West Ecuador, but slightly brighter, more yellowish green above; underparts with much less greenish yellow on sides of breast and flanks, the shade distinctly greener, less yellow than in the typical form.

TYPE.—No. 257,146, Amer. Mus. Nat. Hist.; ♂ ad.; Cape Garachiné, eastern Panama; March 5, 1927; Griscom, Crosby, et al.

SPECIMENS EXAMINED

Pachysylvia m. minor.—West ECUADOR: various localities, 10 ♂, 2 ♀, 2?

Pachysylvia m. darienensis.—Eastern PANAMA: Cape Garachiné, 2 ♀, 1?

This new form is easily recognized by the greatly reduced amount of greenish yellow below. The species is known to Panama only on the basis of one specimen taken by Barbour and Brooks on Mt. Sapo, at a time when only two specimens from Ecuador were available for comparison. Dr. Chapman has already commented on the only known specimen from western Colombia. It resembles the Panama bird exactly in the reduction of greenish yellow below, but is somewhat darker even than the typical form above.

This species was common at Cape Garachiné, living in the tops of the tallest trees, and consequently very difficult to collect. In habits and song it closely resembles *Pachysylvia decurtata*. It is a most persistent singer, or would otherwise be completely overlooked. So high does it range that it is unidentifiable in life even with high-powered binoculars. These factors undoubtedly account for the great preponderance of males in our series.

36. *Compsothlypis pitiayumi nana*, new subspecies

SUBSPECIFIC CHARACTERS.—Most closely resembling *Compsothlypis pitiayumi elegans* Todd of Colombia and Venezuela in coloration, but green patch on back greatly reduced in area (less than half that of other races); size minute, even smaller than the Central American races.

TYPE.—No. 25,714, Amer. Mus. Nat. Hist.; ♀ ad.; Cape Garachiné, eastern Panama; March 5, 1927; Griseom, Crosby, *et al.*

SPECIMENS EXAMINED

Compsothlypis pitiayumi elegans.—Large series from the entire range.

Compsothlypis pitiayumi pacifica.—Large series from West ECUADOR.

Compsothlypis pitiayumi nana.—Eastern PANAMA, the type.

Compsothlypis pitiayumi speciosa.—Large series from COSTA RICA and WEST PANAMA.

The most interesting fact in connection with the bird here under discussion is not that it represents an apparently undescribed form, but that it fills in a notable gap in the distribution of the genus, which has never been recorded between western Panama and Colombia. Its occurrence near sea-level in the Tropical Zone is of course on record for various races (cf. Chapman, 1925, Auk, pp. 193–208). In eastern Panama this can probably be explained on ecological grounds. So far as known all higher altitudes there are covered with the densest type of heavy forest, a type of country in which I have never found the species in other parts of Central America.

The new form here proposed seems sufficiently distinct from *elegans* to justify its recognition on the basis of one specimen only. From *pacifica* Berlepsch it differs in the same respects as from *elegans* and in addition by the much less rich coloration. From *speciosa* it differs radically in less brilliant coloration and in having two well-developed wing-bars, as in *pacifica* and *elegans*.

In addition to the specimen collected, I heard and saw two singing males, but both were out of gun-shot in the gigantic "cuipo" trees.

MEASUREMENTS

14 ♀ *Compsothlypis p. elegans*.—Wing, 50.5–55; tail, 38–43.

1 ♀ *Compsothlypis p. nana*.—Wing, 46.5; tail, 30.

37. *Ateleodacnis leucogenys panamensis*, new subspecies

SUBSPECIFIC CHARACTERS.—Similar to typical *Ateleodacnis leucogenys* (Lafresnaye) of Colombia, but adult males much darker both above and below, the general color dark Payne's gray instead of Payne's gray; adult females slightly darker above, with little or no tinge of green.

TYPE.—No. 257,147, Amer. Mus. Nat. Hist.; ♂ ad.; Cape Garachiné, eastern Panama; March 4, 1927; Griscom, Crosby, *et al.*

SPECIMENS EXAMINED

Ateleodacnis l. leucogenys.—COLOMBIA, 8 ♂, 3 ♀.

Ateleodacnis l. panamensis.—EASTERN PANAMA: Cape Garachiné, 5 ♂ ad., 1 ♂ imm., 4 ♀.

The capture of this bird was one of the great surprises of the trip, and adds a new genus to the fauna of Central America. It proved to be very common in flocks in the tops of the giant "cuipo" trees, and it could be collected only by luck with a charge of heavy shot. The series on which the new form is based is due entirely to the special efforts of Mr. Crosby and Mr. Benson, the original discoverer.

The systematic position of this bird is still in some uncertainty. Mr. Ridgway revived the genus and transferred it provisionally to the Mniotiltidæ on external characters. I carefully examined the tongues of several of the specimens we collected and found that they were moderately slender, the tip only slightly bifid, and not at all fringed to the naked eye. This confirms the mniotiltine relationships of the genus.

The immature male differs from the female in having the upperparts a slightly darker blue-gray, and light chestnut under tail-coverts.

38. *Dendroica castanea* (Wilson).—Bay-breasted Warbler.—This species is almost unknown in Central America, but winters commonly in Colombia. As a matter of fact it winters commonly from the Canal Zone southward. We observed it commonly and collected specimens at every locality visited.

39. *Dendroica fusca* (Müller). Blackburnian Warbler.—One seen by me at Garachiné on March 5 with Bay-breasted Warblers. While common on migration in April, there is no definite winter record for Panama.

40. *Spiza americana* (Gmelin). Dickcissel.—A flock of six at Chiman, March 7, one collected.

41. *Piranga testacea* subspecies —One of the great surprises of the trip was supplied by Mr. Benson, who brought in an adult male of this Tanager from the low hills of Cape Garachiné. In the first place this species, like the Pitiayumi Warbler, has never been recorded between western Panama and Colombia. In the second place it is strictly a Subtropical Zone species and has never been known to occur in the Tropical Zone at sea-level in Central America. Strangely enough, in color this specimen does not differ in the slightest particular from an excellent series of topotypes of typical *testacea* from Veraguas. It is distinctly smaller, however, particularly the bill. Twelve males of typical *testacea* measure as follows: wing, 88.5–96.5, tail, 72–80; exposed culmen, 17.5–19.2. The Garachiné specimen measures: wing, 87; tail, 70.5; exposed culmen, 16. Further specimens are needed, however, to confirm these size differences. As only one individual was seen at Garachiné, it is probable that the headquarters of this species in eastern Panama still awaits discovery.

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HACKBERRY SEEDS FROM THE PLEISTOCENE LOESS OF NORTHERN CHINA¹

BY RALPH W. CHANEY

The occurrence of seeds of *Celtis* in the Pleistocene loess of western Chihli Province, China, is of particular interest in view of their presence in deposits of the same age in southern California and in the Great Plains of North America. The record of this material from the loess of northern China has especial significance since it furnishes the only known evidence regarding the plant life of this region during the Pleistocene. The seeds were collected by Professor George B. Barbour of Yenching University in 1924, and were given to the writer for study the year following. They are here described as a new species, named in honor of their collector.

Celtis barbouri, new species

DESCRIPTION.—Nutlets spheroidal, the outer portion, representing the fleshy layer, shrunken to form reticulate ridges of which the more conspicuous are longitudinal; slightly flattened at the base where an inconspicuous attachment scar can be seen in many specimens, and produced into a short stout point at the distal end; diameter 3.5 to 4.5 mm., averaging 4 mm.; thickness of the shrunken fleshy layer 0.3 mm.; interior hollow in all specimens examined.

These seeds closely resemble the specimens described by the writer from the White River beds of South Dakota under the name *Celtis hatcheri*.² They average smaller in size, and the surface markings are less well defined than is the case in the American material. In view of these differences, and more especially of the fact that living species of the genus are given distinct names in North America and in eastern Asia, it has seemed desirable to consider the specimens from Chihli as representing a distinct species.

LOCALITY.—Gully south of Kuo Ts'un, 5 miles south of Hsuan-hua-fu, and nearly 25 miles southeast of Kalgan, Chihli Province.

COLLECTION.—Univ. Calif. Coll. Pal. Bot., Type No. 151.

In discussing the *Celtis* material from the Tertiary of North America the writer has considered the ecological significance of the occurrence of

¹Publication of the Asiatic Expeditions of The American Museum of Natural History, Contribution No. 73

²Chaney R. W., 1925, Carnegie Inst. Publ. 349, No. 3 pp. 54-56

hackberry seeds.¹ Their presence in rocks which contain no other fossil plant material, together with the habit of present-day species of *Celtis*, is indicative of semiarid conditions. In both the later Tertiary and the Pleistocene deposits of the Great Plains, the only known fossil plants represent seeds and stems and are of rare occurrence.

In the asphalt deposits at Rancho La Brea, California, which contain an abundant and varied mammalian fauna of Pleistocene age, a single seed of *Celtis* has recently been noted.² The floral assemblage at this locality is dominated by juniper, live-oak (*Quercus agrifolia*), and other species now found living in regions of comparatively low rainfall. In such a situation, *Celtis* might be expected to have occurred during the Pleistocene, as it does today, occupying the borders of intermittent streams in the grasslands.



Fig. 1.

Fig. 2.

Figure 1. Seed of *Celtis barbouri* viewed from the distal end. X 4.

Figure 2. Seed of *Celtis barbouri* viewed from the side. X 4.

A similar habitat may be postulated in northern Chihli during the Pleistocene, involving a climate which is in accord with the generally accepted idea for loess accumulation, and which is not greatly unlike that found in the region today. The common living trees noted in this region by the writer are *Ulmus pumila* L. and *Populus* (probably *P. tomentosa* (Carriere)), both of which occupy valleys. *Ulmus pumila* ranges northward for several hundred miles across the grasslands of Inner Mongolia. *Celtis bungeana* Hems. is also recorded in northern Chihli.³ With the present annual rainfall of about 15 inches, the water table is doubtless too low to permit the forming of leaf impressions; and the seeds of *Celtis* alone, because of their larger size and thicker pericarp than those of *Ulmus* and *Populus*, are suited to remain in the sedimentary record. It is therefore suggested that conditions not unlike those of today have characterized northern Chihli as far back as Pleistocene time, and that these seeds of *Celtis* represented the only element of a rather sparse flora which was structurally suited to leave a record in the loess.

¹Op. Cit.

²Frost, 1927, Univ. Calif. Publ. in Botany, Vol. 13, No. 21.

³Sargent, 1916-1917, Plantæ Wilsonianæ, III, 270.

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LAGOMORPHS COLLECTED BY THE ASIATIC EXPEDITIONS¹

BY GLOVER M. ALLEN

The fine series of lagomorphs secured by the Asiatic Expeditions, under the leadership of Dr. Roy Chapman Andrews, includes some 85 hares from such widely separated localities as Mongolia and the Chinese provinces of Shensi, Chihli, Fukien and Yunnan, as well as 136 skins of mouse-hares or pikas chiefly from the Gobi Desert region. The latter appear to represent four well-marked types of which two, *Ochotona pallasii* and *O. dauurica*, are characteristic of the Gobi; a third, *O. hyperborea mantchurica*, is more northern, reaching the edge of the Mongolian plateau; while the fourth type is more characteristic of the high mountains of western China and is allied to the small brown species, *O. tibetana*. The large number of hares available has led me to attempt a revision of the Chinese forms of the black-tailed group to the extent of indicating their subspecific relationship and allocating some of the names previously applied. The harsh-haired rabbit, *Lepus sinensis*, is now referred to the genus *Caprolagus* and a new race is described from the mountains of northwestern Fukien; while from western Yunnan is described a new species of hare allied to *Lepus nigricollis* of India.

***Ochotona hyperborea mantchurica* Thomas**

Ochotona (Pika) hyperborea mantchurica THOMAS, 1909, Ann. Mag. Nat. Hist. (8) IV, p. 504.

A small species, with palatal and incisive foramina separate. Thomas has described the race of eastern Manchuria as slightly larger and brighter russet in color than specimens from the upper Amur region representing Schrenck's *O. h. cinereo-fusca*, and at the same time suggests that these may be a species distinct from *O. hyperborea*, though closely allied to it. The skulls of the latter are much smaller (skull length 31 as against about 40 mm.) and the summer pelage is apparently grayer.

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 74.

A series of over thirty skins was taken at a locality 45 miles north-east of Urga, Mongolia, by the Asiatic Expeditions. These average a very little smaller in measurements than those given for the Manchurian race, but the largest individuals are scarcely inferior to the latter, so that without Manchurian specimens for comparison they seem best considered identical. The presence of a colony of this boreal species near Urga brings its range well to the westward and carries its southern limit to the northern edge of the Gobi Desert. Most of the adults taken July 25-29 have acquired the bright russet pelage of summer though a few still retain on the rump and flanks a remnant of the longer winter fur of a pale ochraceous and black, while in one taken September 11 the new winter coat is coming in on the head, shoulders, and anterior back. The immature individuals of late July are in a dark gray pelage much intermixed with black, while adults are bright russet above, darkened on the middle of the back by black hairs, and on the belly the light tips of the hairs are washed with rusty.

***Ochotona dauurica* (Pallas)**

Lepus dauuricus PALLAS, 1776, 'Reise,' III, p. 692.

A uniform sandy ochraceous above, paler on the sides, feet white washed with buff above; prominent pale buffy patches behind ears. Below, the hairs are slaty at base, tipped with white; a buffy collar on the throat extends back medially as a wash of the same color to chest.

Superficially this species greatly resembles *O. pallasi* which occurs in the same localities with it in the Gobi Desert but may be recognized at once by its feet, the toe pads of which are completely hidden by short forwardly directed hairs, while in *O. pallasi* the pads are naked and obvious at a glance. In details the present species is slightly paler in color, the ochraceous tints not quite as bright on cheeks, sides and rump, the bright tuft of hair below the ear is lacking, and the upper lip is narrowly white like the chin instead of ochraceous like the rest of the head.

A specimen from Turin, Mongolia, May 11, is still in the full soft coat of winter, a pale and uniform ochraceous buff slightly darkened by the minute black tips of the hairs above. Specimens taken about May 18-20 show the new hair coming in on head and shoulders, a condition also shown by specimens taken as late as June 11.

This species possibly breeds earlier than *O. pallasi*, for very small young (length, 105 mm.) were taken some twenty miles southwest of Urga on May 18 and 19, 1922, and others May 21 near Tze Tzen Wang.

Another, equally small, was caught at Loh, July 7, and is interesting in having a well-developed first digit on the right hind foot, but whether on the other hind foot, is not certain, as it is injured.

A December specimen from Kweihwacheng, Shansi, should probably represent *O. bedfordi* Thomas from Ningwufu and Kolanchow, Shansi, and Yen-anfu, Shensi, which is said to differ in its rather larger size and larger bullæ. The measurements given, however, are not greater than those shown by specimens of *O. dauurica* from localities in northern Mongolia. Indeed, some of the latter have even larger bullæ. The Kweihwacheng specimen, though not full grown, appears identical in measurements with Mongolian examples. In its full winter coat, it is a uniform pale sandy buff, with paler post-auricular patches; below white, with a buffy collar which is prolonged as a narrow median buffy line along the ventral region.

***Ochotona pallasi* (Gray)**

Lagomys pallasi GRAY, 1867, Ann. Mag. Nat. Hist., (3) XX, p. 220.

A large sandy-buff (summer) species, with gray belly washed with buff. In the skull the incisive and palatal vacuities are separate.

A series of some fifty specimens was secured in 1922, from localities in the Gobi Desert, Mongolia: Gun Burte, Ussuk, Artsa Bogdo, and 40 miles southwest of Tze Tzen Wang. An adult from the last locality was still in very worn winter pelage on June 1, of a nearly uniform sandy gray above; the feet above and a tuft at the anterior base of the ear pale buffy; rump slightly more ochraceous; throat and middle of belly pale ochraceous. A second adult from the same locality, May 31, is similar but small patches of the ochraceous summer pelage are coming in on nose, base of ears, patch below ears and in the middle of back. Others from Gun Burte, June 21, have new ochraceous hair on nose, forehead, cheeks and a "whisker" patch of upwardly directed hairs below the ear, and still others taken at the same time and place are slightly farther advanced, the new pelage extending from nose to shoulders, and across the posterior part of the back. In somewhat younger (and more vigorous) animals, also taken June 21, the change is complete, the entire dorsal surfaces sandy, with a bright ochraceous tone, clearest on head, neck and rump, the feet paler; belly hairs slaty with whitish tips and a wash of ochraceous across the throat and medially on the belly. About a centimeter below the ear is a small patch of close, upwardly directed hairs, of contrastingly rufous color.

Several small young were taken as early as May 31 and June 1, forty miles southwest of Tze Tzen Wang, and others of about the same size June 21 at Gun Burte, June 25 at Ussuk, and July 11-24 at Artsa Bogdo.

A ready means of distinguishing this from *O. dauurica* is through the naked black pads, clearly visible at the ends of the toes in the present species; also, the hind claws are shorter.

***Ochotona cansa morosa* Thomas**

Ochotona cansa morosa THOMAS, 1912, Ann. Mag. Nat. Hist., (8) X, p. 403.

A dark brown race, having a plentiful admixture of black with ochraceous-tipped hairs. Feet with dark metapodial areas and pale buffy digits. Below, the hairs are white-tipped, the median area, or all but a lateral stripe, washed with ochraceous. The blue-gray bases of the hairs everywhere show through. Soles of hind feet dark brown.

Five skins from Tai Pai Shan, Tsing-ling Mts., at 10,000 feet, are nearly topotypes of this subspecies. From the same region Thomas has described a similar but grayer and white-bellied species, *O. syrinx*, which, however, was not met with by the Asiatic Expeditions.

***Ochotona forresti* Thomas**

Ochotona forresti THOMAS, 1923, Ann. Mag. Nat. Hist., (9) XI, p. 662.

A dark brown species allied to *O. tibetana* but larger and more ochraceous in color.

The type, from 13,000 feet, on the northwest flank of the Lichiang range, Yunnan, is described as larger than any other known member of the *tibetana* group (length 185 mm.). The collection contains a single immature female from 12,000 feet on the same range.

***Caprolagus sinensis sinensis* (Gray)**

Lepus sinensis GRAY, 1833-34, 'Illustrations of Indian Zool.,' II, Pl. xx.

This is the common rabbit of South China, of a bright ochraceous buff, much darkened above by long black hairs, and having a blackish patch on the face below the eye; chin and throat buff, mid-ventral area white.

So different is this rabbit in its external and cranial characters from the more typical members of the genus *Lepus*, that it can no longer be regarded as congeneric with them. In its short ears, short hind foot, short, nearly concolorous tail, and relatively harsh pelage it is obviously

peculiar, and the characters of the skull further emphasize its distinctness. In all these points it shows much agreement with *Caprolagus hispidus* of Nepal and Assam, and I am therefore transferring it to that genus. As in *Caprolagus*, the supraorbital processes are less developed than in *Lepus*, lack the deep notch anteriorly, and their tips do not extend back to the braincase. The postorbital constriction is narrower as well, so that when viewed from above much more of the orbit is visible, whereas in *Lepus*, the large supraorbital process overhangs and hides the greater part of the orbit. In two out of five specimens the sutures of the interparietal bone are distinct all around, but in the others its posterior outlines are obliterated. The bone itself is very narrow. The jugal bone, instead of having its edges raised to form a wide external gutter as in *Lepus*, is flat on its outer surface, with the usual deep excavation near the anterior end. Other obvious differences are the generally heavier nature of the bones of the skull, the narrower opening of the posterior nares, and the smaller bullæ. The teeth agree with those of *Caprolagus* in the heavier form of the incisors with their simple groove (in the upper anterior pair) which, however, is deeper and more filled with cement in *C. hispidus* than in *C. sinensis*. The first upper premolar has three deep subequal re-entrant folds of enamel on its anterior face, whereas in *Lepus* the middle loop is deepest, the two others shallower. In *C. hispidus* the incisive foramina appear to be shorter and narrower than in *C. sinensis*, with the palatal bridge relatively longer, but these differences may be regarded as specific rather than generic.

The name *Lepus sinensis* first appeared on Gray's colored plate, said to have been drawn from a specimen sent by Reeves to the British Museum. As noted by Thomas in another connection, Reeves' mammals came from southeastern China, "more or less in the region of Canton," which may therefore be regarded as the type locality. It ranges northward along the coast apparently at least to the vicinity of Shanghai. The specimens secured by the Asiatic Expeditions are from Futsing and Yenping in Fukien Province, and Tung-lu, Chekiang. In the mountains of northwestern Fukien it is represented by the following subspecies.

***Caprolagus sinensis flaviventris*, new subspecies**

TYPE.—Sub-adult female, skin and skull, No. 84500, American Museum of Natural History, from Chunganhsien, Fukien Province, China. August 1, 1926. Clifford H. Pope, collector; Third Asiatic Expedition.

DESCRIPTION.—Like the typical form but darker, the ochraceous tints deeper and the entire underparts ochraceous buff instead of being pure white mid-ventrally.

General color above a mixture of ochraceous buff and black. The longer hairs are of two kinds: those having a dark blackish base then a broad ochraceous band and a fine black tip; while mixed with these are hairs entirely black, which predominate over the back and rump, and become less numerous on the sides. Head, proœtote and tail above, dark mixed black and ochraceous like the back; sides of the head, especially below the eyes, black, only slightly mixed with ochraceous; an ill-defined pale buffy eye-ring. Neck patch clear ochraceous rufous. Outer margin of ears buff, their metentote and metectote more ochraceous. Fore feet and limbs above ochraceous rufous. Hind feet and entire underparts from chin to lower side of tail clear ochraceous, the bases of the belly hairs gray. A few black hairs are present on the lower throat.

SKULL.—Apparently this is not different from that of the typical race.

MEASUREMENTS.—In the type, the ear from meatus measures 62 mm., the hind foot 88, the tail 55. In a larger, male specimen the hind foot is 98 mm., the ear about 60. The skull of the type measures as follows (with the corresponding measurements of a larger, more mature female of *C. s. sinensis* from Tunglu, Chekiang, No. 45338, in parentheses): greatest length, 77 (84) mm.; basal length, 60.5 (65.5); palatal length, 30 (33); incisive foramina, 18.5 (19.5); nasals, median length, 26 (27); zygomatic width, 37 (37.5); interorbital width, 17 (17); postorbital constriction, 11.5 (11); width of brain-case, 24.5 (26.5); interpterygoid width, 6.8 (6.8); length of bulla from ventral aspect, 9.5 (10); diastema, 19 (20); upper cheek teeth, 14.5 (15.6); lower cheek teeth, 15.5 (16).

Five specimens, including two very young ones, from Chunganhsien, near the northwest border of Fukien Province, all agree in the uniform ochraceous coloring of the under side, instead of being pure white mid-ventrally from the chest to vent. Mr. Clifford H. Pope who secured this series writes that the altitude here is 4000 to 5000 feet; "the mountains are forested and wild and probably reach an altitude of 7000 feet."

A narrow white mark is present on the forehead of the young and some of the adults.

***Lepus tolai tolai* Pallas**

Lepus tolai PALLAS, 1778, 'Nov. Spec. Quad. e Glirium Ord.,' p. 17.

The nomenclature of the black-tailed hares of central and eastern Asia is still much in need of revision. The first applicable name is that of Pallas who in 1778 described *Lepus tolai* which lives "in deserto magno Gobœnsi ubique ad Tybetum usque." In 1894 Thomas described *L. swinhoei* from Chefoo, Shantung Province, China, and other names have since been given to similar hares from that country, though seemingly the differences are slight. In 1907 Satunin gave new names to various Asiatic hares on the basis of small color characters, and with few comparative notes. In this group, the ear from crown is slightly shorter than the hind foot (with claw), there is a pale eye stripe and ring, the

tail is black above and pure white below to the roots, and the sides of the body in the winter pelage have a number of very long white-tipped bristles projecting far beyond the general surface of the pelage. Of the 58 specimens of this type collected by the Asiatic Expeditions of The American Museum of Natural History, as well as in a series in the Museum of Comparative Zoölogy, those from the Gobi Desert are practically all in their summer coat while those from China are in full winter pelage so that strictly comparable specimens are few. It is evident, however, that the hare of the Gobi Desert is paler in winter coat than that of North China, with more prominent gray rump, though within narrow limits there is considerable variation. Satunin regarded specimens from Transbaikalia as typical of *L. tolai* and describes the Gobi Desert hare as a distinct species, *L. gobicus*, but the differences noted are very slight, and it seems unlikely that the hares from Selenga River (which he assumes as the type locality of *L. tolai*) are very different from those inhabiting the northern Gobi, even if it were possible to ignore Pallas's statement that the Gobi Desert is the type region. For the present then, the pale, gray-rumped hare of the Gobi Desert may be considered as *L. tolai*, of which *L. gobicus* is a synonym. The species is represented in the collections of the Asiatic Expeditions by specimens from thirty miles south of Ude, thirty miles south of Urga, from Erhlien, Tsagan Nor, Ussuk, Artsa Bogdo, and Ula Usu, Mongolia.

***Lepus tolai swinhoi* Thomas**

Lepus swinhoi THOMAS, 1894, Ann. Mag. Nat. Hist., (6) XIII, p. 364.

A brighter colored, more buffy race, with slightly longer nasals than typical *L. tolai*.

More than thirty years ago Thomas pointed out the characters distinguishing the Chefoo Hare from the grayer form of the Gobi Desert, but although the two have since been regarded as distinct species, there seems now no doubt of their closer relationship, and I have therefore regarded the former as a subspecies of the latter. In winter pelage Swinhoe's Hare is mixed buffy and black above, with a number of long white-tipped hairs projecting beyond the rest of the pelage on the sides. The summer coat is shorter and lacks these longer hairs.

A number of specimens from the Peking region secured by the Asiatic Expeditions represent this race. Others from Shansi are obviously less yellow in winter pelage with a very pinkish tint, while a few from the Ichang region in the Yangtze Valley are richer in tone becoming almost rusty. Since names are available for these geographic variants, they are

recognized as below. Typical *swinhoei* was described from the Shantung peninsula, and the Peking specimens are assumed to be the same. In winter coat they are pale yellowish above, but some are hardly distinguishable from the next race. A large proportion (six of 13 skins) show more or less mixture of buffy-tipped hairs with the black of the tail, a character used by Matschie as the basis of his *Lepus stegmanni*, shown by Thomas to be a synonym of *L. swinhoei*.

Lepus tolai filchneri Matschie

Lepus filchneri MATSCHIE, 1908, 'Exped. Filchner nach China und Tibet,' X, pt. 1, pp. 217-219.

Lepus swinhoei brevinasus J. A. ALLEN, 1909, Bull. Amer. Mus. Nat. Hist., XXVI, p. 427.

Lepus swinhoei sowerbyæ HOLLISTER, 1912, Proc. Biol. Soc. Washington, XXV, p. 182.

The series of black-tailed hares collected by the Asiatic Expeditions includes ten from Kweihwacheng, northern Shansi, in freshly assumed winter coat (October 22-24), and four (one in winter coat) from the Tai Pei Shan region of southern Shensi. All are quite similar in color and undoubtedly represent *L. filchneri* described by Matschie from Hingan-fu, southern Shensi, with the description of which they quite agree. They show an average difference in coloring that separates them from the grayer form of the Gobi Desert, true *tolai*, but their similarity to the Chefoo Hare, *L. t. swinhoei*, is rather closer. They may usually be distinguished, however, by the decidedly pinker, less yellowish, tint of the back and sides, and by the buffier tint of the back and exposed inner portion of the ear including its fringe of longer hairs at the outer edge, portions which in *swinhoei*, as represented by specimens from Peking, tend to be white or whitish, even forming a contrasting white edge above and below. In addition there is less tendency to a mixture of buffy hairs with the black of the tail, and the nasal bones of the skull average slightly shorter. A winter specimen from Tai Pei Shan is quite the same as the Kweihwacheng series. Three others from near Sianfu, Shensi, are in summer pelage which is much shorter, and uniformly pale yellowish (buff) grizzled with black above, clear buff on the sides and limbs, and without the long whitish bristles of the winter coat. There is no doubt that Hollister's *Lepus swinhoei sowerbyæ* (1912) from northern Shansi is the same. He compared it with the pale race *subluteus* of the Ordos Desert and described it as having a grayer rump, lighter pinkish-buff chest-band and more white on the under side of the fore legs, char-

acters which prove to be rather variable when a series is examined. It is possible that *Lepus gansuicus* Satunin (1907) from Kansu may prove indistinguishable, in which case this name has precedence.

***Lepus tolai aurigineus* Hollister**

Lepus aurigineus HOLLISTER, 1912, Proc. Biol. Soc. Washington, XXV, p. 181.

In the southern part of its range in China the black-tailed hare responds to the warmer and moister climate by a marked increase in the brightness of its yellowish tints. In winter pelage the entire upper parts are bright ochraceous much mixed with black; the spot before the eye, the eye-ring, inside of ears and their borders are rich ochraceous, the fore legs and chest-band pale cinnamon, the sides clear buff. Hollister's *Lepus aurigineus* is evidently this form, which may now be considered a race of *L. tolai*. The type locality is Kiu Kiang, northern Kiang-si.

Through the kindness of Mr. G. S. Miller, Jr., U. S. National Museum, I have been able to compare the type with other Chinese specimens, and it is unquestionably a member of the *tolai* group. Though nearly full-grown it is nevertheless immature as indicated by the skull, while the skin itself has the appearance of having been prepared from an alcoholic specimen. It lacks the tail and is obviously somewhat faded.

A series of winter skins, collected by the late W. R. Zappey in western Hupeh Province for the Museum of Comparative Zoölogy, is referred to this race while two others from Wanh sien on the eastern border of Szechwan, secured by the Third Asiatic Expedition of The American Museum of Natural History, are nearly similar, though one is less ochraceous than the other. Probably these two are best regarded as intergrades between the two subspecies, *filchneri* and *aurigineus*.

***Lepus comus*, new species**

TYPE.—Adult female, skin and skull, No. 43174, American Museum of Natural History, from Teng-yueh, Yunnan Province, China, 5,500 feet altitude. April 19, 1917. R. C. Andrews and E. Heller.

DESCRIPTION.—Related to *L. nigricollis* but with longer hind foot, color darker, less buffy, the nape dull brown, the tail beneath and bases of belly-hairs pale slaty gray.

Head, above, dull ochraceous buff, slightly mixed with black, a whitish band from the muzzle to the base of the ear, including both eye-lids; cheeks grizzled buffy, gray, and black. Nape patch dull russet with many pale-tipped hairs. Ears dark, the proëctote grizzled buffy and black, the anterior edge with a fringe of longer grayish hairs on its basal three-fourths, the posterior edge clearer white; tip of ear, both its edge and posterior terminal half of metectote, dark brown; base of metectote sparsely covered with short grayish hairs. Inside of ears with very few pale hairs, but an ill-

defined dark brown submarginal border basally. The back is a very dark mixture of buffy and blackish in about equal proportions. The individual hairs are about 32 mm. long, grayish at base, then ringed with ochraceous, then with black, succeeded by a buffy tip. On the rump these rings become very much paler and the tips whitish, resulting in a grizzled gray appearance. The flanks, fore legs from elbow, and outer side of hind legs and backs of hind feet are clear ochraceous buff. The tail is peculiar in being grizzled blackish-brown and whitish above like the rump, and gray faintly tinged with buffy below, the basal portion of all the hairs pale slaty gray instead of pure white. The throat band is clear ochraceous with a sprinkling of longer white-tipped hairs. Chin, inner sides of legs to elbow and heel white; the chest and belly white with blue-gray bases except anteriorly where the hairs are pure white throughout their length.

SKULL.—In general structure the skull is very different from that of the black-tailed hares of the *L. tolai* group, but closely resembles that of *L. nigricollis*. In the former the anterior edge of the orbit forms a slight wing standing out at right angles to the long axis of the skull, but in the latter the sides of the rostrum come straight back to this edge so that there is little if any projecting rim and the base of the rostrum appears much broader in proportion. The supra orbital processes are more slender with their anterior arm marked off by a short narrow slit in *L. nigricollis* and *L. comus* but in the *tolai* group are widely notched in front, and in addition are turned slightly upward, so that in profile they stand up above the general contour of the skull. In *L. comus* and *L. nigricollis* the profile is evenly convex whereas in *L. tolai* the nasals are less depressed and the dorsal outline of the braincase is more sharply bent downward. The meatus of the ear is also directed more posteriorly in the two first. In ventral view the inner margin of the bulla is broader and its foramen more prominent. The groove on the front face of the incisors is continued backward with two short lateral arms, forming a Y. The portion internal to this groove projects forward beyond the level of the outer part of the tooth.

MEASUREMENTS.—The type measured: length, 480 mm.; tail, 95; hind foot with claws, 130; ear, 97. The skull of the type and an imperfect one of a second specimen from the same locality measure: greatest length, 95, —; basal length, 76, —; palatal length, 39.5, 37; diastema, 27.5, 25; nasals, greatest length, 41, 41; length of contact medially, 31, 31; greatest width, 24, 23.5; zygomatic width, 42.5, —; mastoid width, 30, —; width outside molars, 26, 26.5; outside lacrymals, 35.5, 32+; upper cheek teeth, 17.6, 17.4; lower cheek teeth, 18.2, 17.5; jaw, condyle to tip of bone at base of incisors, 70.5, 67.5.

The discovery of this hare is a matter of great interest, since it is closely allied by the characters of the skull to *L. nigricollis*, the black-necked hare of the Indian peninsula and Ceylon (subspecies *singhala*), but differs strikingly in color, especially in the dark back with its lack of bright buffy and the dull russet instead of black nape, the gray bases of the white hairs of the belly, and particularly in the tail which is pale slaty gray underneath. In its large size, notably of the hind foot, it differs further from *L. nigricollis*. The species *L. siamensis* and *L. peguensis* are much smaller and probably are more nearly related to *L. hainanus*. The skull of the type is peculiar in lacking all trace of the

small second upper incisors but they are present in a second specimen from the type locality. This latter and a young one taken May 10, and an imperfect skin from Lichiang, 8200 feet, agree in all essentials of coloring. A note by the collector states that the type contained two large embryos. Apparently these are the first hares to be recorded from western Yunnan although Wroughton (Journ. Bombay Nat. Hist. Soc., 1915, XXIII, p. 477) mentions that Major Harington secured some hares "beyond Bhamo," eastern Burma, which were "certainly not" *L. peguensis*, and may have been the species here described.

***Lepus hainanus* Swinhoe**

Lepus hainanus SWINHOE, 1870, Proc. Zool. Soc. London, pp. 233, 639, Pl. XVIII, text-figs. 1-4.

A small hare with relatively short stiff pelage and dark coloring, a mixture of dull ochraceous and black above; a prominent white eye-ring, continued to muzzle; fore legs and throat-band bright ochraceous rufous, hind legs paler; chin, belly and under side of tail pure white to the roots. Foot about 85 mm., ear 75.

A series of these hares from Nodda, Hainan, includes a number of partly grown young taken from January to July. Compared with the hares of North China and Mongolia this differs in several minor points, such as the narrowness of the posterior narial opening, the small size of the bullæ, and the peculiar form of the groove on the front face of the upper incisors. This last, instead of being a simple V-shaped groove with its apex posteriorly, is Y-shaped with the two diverging arms extending as re-entrants posteriorly, the whole filled with cement.

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A NEW SPECIES OF THE FAMILY TABANIDÆ FROM THE BELGIAN CONGO, WITH NOTES ON THE GENERIC POSITION OF RELATED SPECIES¹

BY JAMES S. HINE

The two generic names proposed by Grünberg, *Orgizomyia* and *Thriambeutes*, and one proposed by Surcouf, *Guyona* are separated on antennal, palpal and other minor characters which it seems are more properly specific than generic. At least there are more pronounced differences, in the structures named, within other single genera of the Tabanidæ than in these three taken collectively. True, the three species considered as genotypes may* be separated by the characters given as generic, but when it becomes a matter of including the other species which have been discovered, some of them are as properly classified under one as the other. For example, Surcouf described *Pangonia v-album* in 1908 and afterwards transferred it to *Orgizomyia* in his paper in 'Genera Insectorum,' while Austen described *Thriambeutes fuscus* in 1920 and later wrote in a letter that he considers *v-album* and *fuscus* synonymous names for the same species, with the statement that Surcouf's description was overlooked for a time.

At least five species have now been referred to *Orgizomyia*, *Thriambeutes* and *Guyona*, namely: *O. zigzag* (Macquart), the genotype of the first, *T. singularis* Grünberg, the genotype of the second, *G. mesembrinoides* Surcouf, the genotype of the third, *O. v-album* Surcouf and *austeni*, new species, described below, besides *T. fuscus* Austen, now considered a synonym of *O. v-album* Surcouf. We originally wrote the description of *austeni* under *Thriambeutes* but later found characters somewhat intermediate so it was difficult to maintain this conclusion.

The species named may well be considered as a rather compact group of nearly related forms and, in our opinion, all included under one genus. A review of the literature and reference to the material at hand merits the following remarks: *singularis*, *zigzag* and *austeni* are known from both sexes, *mesembrinoides* from the female only, and *v-album* and its synonym *fuscus* from the male only. Slender palpi is one of the char-

¹Scientific Results of the American Museum Congo Expedition. Entomology No. 15.

acters which Grünberg used to designate *Orgizomyia*, while *Thriambeutes* is given as having enlarged palpi. Both sexes of *austeni* have narrower palpi than *singularis*, the male especially having palpi less than half the size of the palpi of the male of that species. Austen describes the palpi of *fuscus* as "elongate and curved but not conspicuously swollen, considerably smaller and narrower than in the male of the genotype," by which he means *singularis*. Surcouf figures the palpi of the male of *v-album* as rather long and slender. Another character used to distinguish *Orgizomyia* is enlarged antennal segments. The facts at hand show that *zigzag* has enlarged antennal segments and *singularis* has slender antennal segments. Austen says of *fuscus*, "first joint of antenna blackish brown, short, swollen, cylindrical" and "expanded portion of the third joint rather broad." In *austeni* the first antennal segment is swollen and the third segment is wide basally in both sexes; moreover there is a slight variation in the various specimens of the series in this regard, for in some there is shown along the dorsal side of the third antennal segment a slight prominence, somewhat suggestive of what Grünberg figures for *zigzag*. Grünberg gives ocelli developed for *Orgizomyia* and ocelli lacking for *Thriambeutes*. Austen says, "ocelli present" in *fuscus* and Surcouf says "vertex portant trois ocelles" for *v-album*. All the specimens of *austeni* studied in both sexes have three well-developed ocelli present. Lastly we find ocelli present in our specimens of *singularis*, the male especially having them very well developed. We note that Grünberg says of the tibia of *Thriambeutes*, "Vorderschienen gebogen und verdickt," but is not definite in this particular with *Orgizomyia*. Enderlein, in his newly proposed system of Tabanidæ, in some way, whether from specimens or from literature is not apparent, puts in his key "Schienen wenig verdickt" for *Thriambeutes* and "Vorderschiene besonders verdickt" for *Orgizomyia*. This indicates that it is doubtful if any distinctive characters are to be found in the front legs. The specimens we have studied show nothing in this particular we can consider generic. Grünberg figures the anal cell of *Orgizomyia zigzag* as narrowly open, Surcouf figures the same species as having it closed and petiolate and likewise for *T. singularis* and *O. v-album*. In our specimens we find this cell closed and petiolate in both wings.

Surcouf's description of *Guyona* is rather brief and freely translated is as follows: Style of the third antennal segment composed of four annulations, basal or first annulus of this segment forming a large flat expansion, one and one-half times as long as wide, bearing a sharp tooth at its middle and diminishing in width gradually to its extremity or to

the beginning of the pleurisegmented style. Palpi long, large, thick, convex above and sinuous beneath. All the marginal cells of the wing wide open.

The situation may be stated as follows perhaps: Either we must construe genera more widely or else erect a genus for nearly every species in this section of the family Tabinidæ.

***Orgizomyia austeni*, new species**

Both sexes with the head and its appendages, entire thorax and wings, anterior legs and middle femora, black. Abdomen, middle tibia and tarsi, and posterior legs, yellow.

FEMALE.—Length of body (several specimens), 12 to 16 mm.; width of head, 3 to 4 mm.; width of front at vertex, scarcely half a millimeter in the largest specimens; length of wing, 11 to 14 mm.

Head: front black, somewhat shiny, slightly wider below than at vertex; ocelli distinct and somewhat elevated, surrounding region of the same color as the rest of the front; face and cheeks black, somewhat shiny; antennal protuberance very prominent, much larger and more protuberant than in the female of *singularis*, shiny black; first antennal segment shorter and more slender than the protuberance, somewhat swollen; second antennal segment about one-fourth as long as the first, small; entire third segment distinctly longer than the first two together, plainly divided into basal and annulate portions, of which the former is wide at base and narrowed to apex and distinctly longer than the latter. The second and third antennal segments are opaque brownish black, while the first is shiny black. Palpi opaque brownish black, rather large, curved, and plainly shorter than the rather slender black proboscis. Thorax and scutellum black, shiny. Abdomen entirely brownish yellow above and below. Wings entirely black. Halteres brown. Legs: front pair black throughout, middle femur black, but not so intense toward apex where this color is softened by yellowish; front tibia and tarsi yellow; hind legs yellow, except the extreme base of each femur is slightly infuscated.

MALE.—Length of body (several specimens), 10 to 13 mm.; width of head, 3 to 4 mm.; length of wing, 10 to 12 mm.

This sex is colored exactly like the female. Head with the eyes widely in contact, area of enlarged facets extensive and practically surrounded by the small facets which are very few at vertex; but the encircling band of them widens toward the inferior outer angles of the eyes and narrows again as the antennæ are approached. In some dry specimens of this sex the area of enlarged facets is nearly black in color, but in most it is distinctly light brown and in evident contrast with the color of the area of small facets which is invariably black. However this condition may be seen in many other species of Tabinidæ after they become dry in collections. Palpi short and much smaller than in the male of *O. singularis* (Grünberg).

Holotype female and sixteen paratype females, allotype male and eleven paratype males from Stanleyville, Belgian Congo, March, 1915 (Lang and Chapin Coll.), taken from *Bembix*. Seven paratype females and ten paratype males taken April 9, 1915. Four female paratypes and two male paratypes, taken April 7, 1915. Two paratype females and three paratype males, taken May, 1915. Nine paratype fe-

males and six paratype males without date. All collected at Sanleyville, Belgian Congo, by Lang and Chapin and all taken from *Bembix*. 72 specimens in all, 39 females and 33 males.

I take pleasure in naming this species for Major E. E. Austen of the British Museum. He has described a large proportion of the Tabanidæ of the African Continent and has published much on their distribution and habits.

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RESULTS OF THE DOUGLAS BURDEN EXPEDITION TO THE ISLAND OF KOMODO

I.—NOTES ON *VARANUS KOMODOENSIS*^{1, 2}

BY EMMETT REID DUNN

The following notes concerning the giant lizard of Komodo relate to the size attained, to the range, to its relationship to other living species, to its relationship to the various described varanid fossils, and to the problem presented by the known facts.

Varanus komodoensis was described by Ouwens in 1912. His material consisted of five specimens, all from Komodo, none of which were apparently sexed. The total length of these five measured 2.9 m., 2.35 m., 2.2 m., 1 m., 1 m., respectively. The largest may be taken as the type of the species; it is at present mounted in the Museum at Buitenzorg.

De Rooij described a specimen, sex not mentioned, from Labuan Badjo on the west coast of Flores, in 1915. This specimen measured 2.66 m.

The Duke of Mecklenburg in 1923 collected four specimens on Komodo. Of these, three are in the Museum at Buitenzorg and were seen by me, while the fourth is in the Berlin Museum. None of these has the data concerning the sex. The three in Buitenzorg are under 2.5 m. The Berlin specimen, according to the authorities in Buitenzorg, is under 3 m.

Horst (1926) shot a specimen on Rinja, which was just under 2 m.

While a member of the Douglas Burden Expedition to the Island of Komodo in 1926, I had the opportunity to take measurements and sex data on a number of individuals. I saw also a number whose lengths I am sure I did not underestimate. This material consisted of 17 whose sex I could determine, of 10 additional which I could measure, of 2 skeletons found in an abandoned native trap whose lengths I could

¹Contributions from the Department of Zoölogy, Smith College, No. 143.

²The Douglas Burden Expedition to the Island of Komodo obtained herpetological material from the islands of Pulo Weh, Java, Bali, Lombok, Sumbawa, Komodo, Padar, and Wetar. For the pleasure of accompanying the expedition as zoölogist I am indebted to the leader, Mr. Burden. The herpetological results will be published in four papers, dealing, respectively, with *Varanus komodoensis*, the snakes, the lizards, and the frogs.

estimate, and of 27 specimens seen in the field by me personally which are additional to those already mentioned. I took considerable pains to count the actual number seen by me and to make this number an underestimate. In this way, then, I can assert that I saw on Komodo, in the flesh, at least 54 specimens of *V. komodoensis*. Of these 54, the largest (a male) measured 2765 mm. in total length, the head and body 1380 mm.; the second largest, also a male, measured 2680 mm. in total length, the head and body 1380 mm.; the third largest, not sexed, with broken tail, measured head and body 1355 mm. The larger of the two skeletons had a lower jaw length of 250 mm. The two largest whole specimens had a lower jaw length of 255 mm. These were the four largest specimens to come under my observation.

Of the 17 specimens sexed, the 14 largest were males. Of the 3 females the largest was 6 feet, 6 inches, or under 2 m. One more specimen has been sexed, the larger of two taken to Bima by natives and later sent to Holland. This was a male. The lower jaw measurement given by de Jong (1927) is 210 mm., thus indicating an animal distinctly smaller than either of the two largest ones mentioned above.

Finally, 20 skins were sent in the early days of 1927 by native poachers from Komodo to Macassar. Some of these skins found their way to London where one came under the observation of Lord Rothschild (1927) and three of Mr. Burden. None of those seen were over 2.5 m.

This evidence based on 73 specimens gives no indication that *Varanus komodoensis* reaches a length of over three meters. In fact, the largest actual specimen on record is the type. It indicates that males alone reach great size.

The only evidence on a greater size is contained in the original description among information transmitted to Ouwens by Mr. J. K. van Steyn van Hensbroek. He says that Sergeant Beker shot one 4 m. long on Komodo, and that Messrs. Aldegon and Koch informed him that the former had shot some between six and seven meters in length on Komodo, when they first visited the island. There is absolutely no material evidence to support these statements.

The original description states that the animal is found on Komodo and on the west coast of Flores at Labuan Badjo. Horst (1926) mentions Mboera on the west coast of Flores and gives a definite record for Rinja, an island about the size of Komodo and between it and Flores. The only other island of any size nearby is Padar, between Komodo and Rinja. We saw tracks on the east coast of Padar which were indistinguishable from those seen on Komodo, and the natives of Komodo told us that the

lizards were found there. It is probable that these tracks were those of *komodoensis* and not *salvator* (the only other *Varanus* of the region) since apparently the two do not occur together, at least it is fairly certain that *salvator* does not occur on Komodo, although it is found on Sumbawa to the west and on Flores to the east. Whether the two are found together in Flores, or what the relationships between them when or if they meet, is an interesting question. Horst (1926) says of its range on Flores: "That its range on Flores may have been formerly more extensive (than 'a . . . strikingly small region of the extreme west') is very probable, although the animal is apparently restricted to a particular terrain, as may be deduced from the regions in which it maintains itself at present. This type of country consists of bare rocks and broken ground, grown up with *alang-alang* grass and bushes mingled with open woods and solitary *lontar* palms; although this country in the dry season presents a very barren aspect it is not lacking in game. Especially Komodo and Rinja . . . are rich in game in the form of deer and wild pig."

The relationships of *V. komodoensis* to the living fauna seem fairly simple. Using Boulenger's synopsis and characters (scalation, shape and position of nostril, and shape of tail) *komodoensis* comes nearest to *Varanus varius* of Australia. In scalation it differs from *varius* in having 80-97 ventrals as against 120-130 in *varius* and in having much more enlarged nuchal scales. The proportions are of course different, *varius* being a much slimmer beast with a longer tail, and the coloration, especially of the throat and belly, is different, the black ventral bars of *varius* being wholly absent.

Near also are *giganteus*, *gouldii*, and *boulengeri*, all Australian species. But both *giganteus* and *gouldii* have more ventrals than *varius*, and neither have the large scales on the snout which are so prominent in both *varius* and *komodoensis*. Neither *gouldii* nor *boulengeri* have the terminal nostril which is present in the other three. I have not seen *boulengeri* but the other four all agree in the possession of osteoderms which are commonly supposed to be absent in Varanidæ. These are present in the nuchal scales of both *varius* and *gouldii*, they seem to be all over *giganteus*, and in *komodoensis* there is not only one below each scale, but on the head they form a curious network of anastomosing little bones, more like the skeleton of a starfish than anything else. Perhaps other species of *Varanus* might, on examination, belong with this group, although they form a section in Boulenger's key, but none I have seen do so. While *varius* and *komodoensis* are nearly allied, there is no possibility of per-

forming a diethotomy on the genus, since *Varanus* consists of a rather homogeneous series separated only by minor technical characters, and occasional more peculiar forms, each obviously related to another more normal. Thus *varius* could not be separated from the mass on any pretext, and there is no character whereby *komodoensis* could be removed without taking *varius* with it, save only proportions, which will be discussed below.

Rothschild (1927), on the basis of one of the skins, makes the statement that *komodoensis* is allied to *albogularis* of West Africa, because the two have similar scales. I have not seen *albogularis* but, according to the literature, the two differ in every other character, while, as a matter of fact, the scales of *komodoensis* and *varius* are exactly alike.

The fossils allied to the living genus *Varanus* have been treated by Fejérváry (1918), by Gilmore (1922), and by Camp (1923). These authors allow at least three genera: *Varanus*, *Megalanina*, and *Saniwa*. They furthermore allow the other two genera subfamily or family distinction from *Varanus*. Gilmore has found a sufficient difference between the skeleton of the American Eocene *Saniwa ensidens* and that of *Varanus salvator* to regard them as belonging to different genera of the family. In this opinion I am content to follow him, seeing no reason for the erection by Camp of a subfamily *Saniwinæ*.

The Old World fossils are considered by Fejérváry. He himself had access to little of the material, taking his information from descriptions and figures. I have access to none of it and am compelled to rely almost entirely on Fejérváry's paper. He regards the fossil material as representing two well-established species from Europe, the earlier *cayluxi*, and the later *marathonensis*: one from India, *sivalensis*; and three from Australia, *priscus* (*Megalanina*), *dirus*, and *emeritus*. All the Australian fossils are late, probably Pleistocene. The Indian is Pliocene. The dates of the European ones are various, none known with certainty to be earlier than Miocene, the later perhaps persisting until the Neolithic.

Of all these fossils the best preserved portions are the dorsal vertebrae. These immediately range themselves into three classes: (1) those with small condyles and large neural canals; (2) those with larger condyles and narrower neural canals; and (3) those with extremely large condyles and extremely narrow neural canals. To the first category belong *cayluxi*, *sivalensis*, and most of the known modern species. To the second belong *marathonensis* and *komodoensis*. To the third belongs *priscus*. Thus the relationship between height of condyle and diameter of neural canal is $\frac{1}{4}$ in *cayluxi*, $\frac{1}{2}$ in *sivalensis*, $\frac{1}{4}$ in *griseus*, $\frac{1}{2}$ anteriorly

and $\frac{3}{4}$ posteriorly in small *komodoensis*, $\frac{3}{4}$ anteriorly and $\frac{3}{4}$ posteriorly in large *komodoensis*, about $\frac{3}{4}$ in *marathonensis*, and $\frac{3}{4}$ in *priscus*. These figures are an index of the weight and thickness of the osseous growth. They show, as do a number of similar measurements which might be given, that three species of the varanoid group are known to have attained a "chunkiness" or stoutness surpassing that of the ordinary, slim type as exemplified by *varius* or *salvator*. They possibly show relationship between these three species. But here a note of warning must be sounded. I have been able to compare a skeleton of *griseus*, a skull of *salvator*, a skull of *giganteus* (in the Smith College collection and apparently the only specimen of the species outside of Australia except the types in the British Museum), and excellent figures of skulls of *niloticus* and *exanthematicus* (Schmidt, 1919, Figs. 8-10) and there is no indication that weight and thickness of osseous growth is at all correlated with any other skeletal characters, for in practically all points save thickness the skull of *komodoensis* agrees with that of *giganteus*, and the two are opposed to the skulls of *salvator*, *griseus*, *niloticus*, and *exanthematicus*, although there is ample difference between all these forms. *Komodoensis* differs from all in the extreme length of the paroccipital processes, but *giganteus*, while nearer the rest in this respect, is intermediate. Correlated with this, the dentary portion of the lower jaw is only three-fourths the length of the angular portion in *komodoensis* and *giganteus*, while in the others examined the dentary part is as long or longer than the angular part. In the SHAPE of a great many bones, irrespective of their thickness, there is greater agreement between *komodoensis* and *giganteus*, such as the flange on the proötic process of the paroccipital, the parietal, the posterior end of the nasal, the anterior end of the frontal, the maxilla, the pterygoid, the palatine, the transverse, and all the bones of the lower jaw.

One is led to conclude from this that the thickness of the bones rather obscures than illuminates the true relationships and that shape rather than size should be considered.

Another way of considering the vertebræ is the relation of width to length. They are all wider than long, but the length is .7 per cent of the width in *cayluxi*, .71-.76 per cent in *griseus*, .531 per cent in *marathonensis*, .545-.578 per cent in old and .6 in young *komodoensis*, .54 per cent in *niloticus*, .487 per cent in *sivalensis*, and .3-.357 per cent in *priscus*, thus giving a totally different arrangement of the forms. But here both *cayluxi* and *sivalensis*, which are almost at the extremes, have nearly cylindrical centra with no obvious precondylar constriction and thus differ markedly from the majority of the species (resembling the Ameri-

can fossil *Saniwa ensidens*). The relative broadness of the vertebra of *sivalensis* is caused not by shortening of the centra but by the great development of the transverse processes, in which character it stands alone. A proper arrangement of these vertebræ would place *cayluxi* at the base of the series with *griseus* next. *Sivalensis* would appear as an aberrant offshoot, while *marathonensis*, *niloticus*, and *komodoensis* are more or less alike and stand between *griseus* and *priscus*. Adult *komodoensis* has rudimentary zygosphenes, thus approaching *priscus*. Other species lack them.

In other skeletal features material is scantier and even less conclusive. The femur of *cayluxi* offers no characters which I can use. The limb bones in general offer fewer characters in *komodoensis* which can be disassociated from size and thickness than do the skull and the vertebræ. The maxilla of *marathonensis* seems to have more vertical sides and thus approaches *griseus* rather than *komodoensis*. The humerus of *sivalensis* is smaller than that of large *komodoensis* (distal end 60 mm. wide as against 70 mm. in *komodoensis*). The width of the combined ulnar and radial condyles is much greater in *komodoensis* (45 mm. as against 31 in *sivalensis*). The figure, however, gives the impression that the humerus of *sivalensis* is a longer and slimmer bone, and does not have the hourglass shape seen in *komodoensis* and present to an even greater extent in *priscus*. Thus a humerus of *priscus* measures 170 mm. in length, breadth at distal end 106 mm., breadth of shaft 32 mm. The same measurements in *komodoensis* are 150 mm., 70 mm., and 20 mm., so that the humerus of *komodoensis* measures seven times the least breadth of the shaft and that of *priscus* five times. *Priscus* is said to have a humerus three times as long and 4.5 times as broad as that of *varius*. *Komodoensis* would then have a humerus 2.6 times as long and 3 times as broad as *varius*, and would be intermediate between the two. The humerus of *sivalensis* would probably have been nearer that of *varius*, and might have measured on that basis 146 mm. and thus nearly as long as that of *komodoensis*. The ulnar condyle is about twice as wide as the radial condyle in *komodoensis* and is quite flat, thus differing from that of *sivalensis*, where the radial condyle is nearly as wide as the ulnar and distinctly rounded. De Vis (1889) says of the humerus of *emeritus*: "affinities with *V. varius* in the prominence and length of its supinator ridge, but with *gouldii*, *punctatus*, etc., in the distinct rotundity of its ulnar condyle and relatively increased prominence of the radial." In both these characters *komodoensis* agrees with *varius* as against *sivalensis*, *emeritus*, *gouldii*, and *punctatus*.

De Vis further describes a tibia of *emeritus* as having certain characters of *varius* and others of *gouldii*. The *varius* characters are quite noticeable in the tibia of *komodoensis*, but not the *gouldii* characters.

The ulna of *priscus* is described and figured by de Vis. The length was 258 mm., and the breadth at the proximal end was 72 mm. The same measurements in a large *komodoensis* are 163 mm. and 30 mm. As in the humerus the relation of length to breadth is less in *priscus* (3.58) than in *komodoensis* (5.4). *Varius* has an ulna almost like *komodoensis*, as the same relationship in it is 5.37. Furthermore, de Vis mentions several features in which the ulnas of *priscus* and *varius* resemble each other, and all these features are found in *komodoensis*. Finally, there are the skull fragments attributed to *priscus* and to *dirus*.

Dirus was based on a single tooth whose figure resembles that of *komodoensis* very accurately. It seems to have had fewer ribs and to have been flatter. It is somewhat larger, 17×8 mm., while a tooth of a large *komodoensis* measures 14×7 mm. This tooth of *dirus* was three times the size of a tooth of a five-foot four-inch *V. varius*, and hence the animal was assumed by de Vis to have been 16 feet long, but the *komodoensis* was certainly not over nine feet in length, and if *dirus* had similar proportions it would have been under eleven feet long.

A jaw, referred to *dirus* by de Vis and somewhat questioned by Fejérváry, has teeth which show a more sigmoid flexure than obtains in either the first type tooth of *dirus* or in the teeth of *komodoensis*. It shows a character in the maxilla which I have seen elsewhere only in *komodoensis*, and this is the development of a wide alveolar surface. The prefrontal process is much more developed, however, and the two are certainly not conspecific. The teeth are proportionally much larger (one-third again as large in a jaw of the same size) but *komodoensis* has much larger teeth than *giganteus* of similar size.

The dentary fragment of *priscus* is from the anterior region and differs markedly from *komodoensis* in its very narrow alveolar surface. It presents the remarkable combination of teeth nearly twice the size (15 mm. in width at the base, 9 mm. in *komodoensis*) in a dentary which is indeed thicker but of no greater height, so that the bone seems too weak to have borne such teeth. This is the most puzzling feature presented by the remains of *priscus*.

The base of the skull of *priscus* offers a few characters for comparison: there is a strong ascending process on the supraoccipital, which is much more nearly approached by *giganteus* and by *komodoensis* than by *salvator*; the condyle of *priscus* is much wider than the foramen magnum,

and this condition is somewhat present in *komodoensis*; the foramen width enters the condyle width 1.78 times in *priscus*, 1.5 times in large and 1.3 times in small *komodoensis*, 1.05 times in *salvator*, and 1.02 times in *giganteus*. This again is a matter of the weight and thickness of ossification, and, as in the relation of condyle to nearal canal, *komodoensis* is intermediate between normal forms of the genus and the very heavily built *priscus*.

An illustration of the way in which this weight of bone increases in *komodoensis* with age is seen in the frontal. Here in small specimens the height of the nerve canal is 3.5 mm., and the thickness of the overlying bone is 4 mm. In large ones the canal measures 4 mm., and the bony roof is 9.5 mm. thick.

Of the fossil species *sivalensis* has such different proportions from *komodoensis* that Lydekker's comparison with *salvator* and estimation of eleven feet may be accepted as correct. *Emeritus* seems to have been slim like *varius*, but half again as long. This might make a lizard ten to twelve feet in length. The maxilla referred to *dirus* is decidedly smaller than that of adult *komodoensis*, although the type tooth is larger. The maxilla is no longer than that of a six-foot six-inch *komodoensis*, but the teeth are about one-third again as large, thus forming an intermediate in this respect between *komodoensis* and *priscus*, and leading one to suppose that *dirus* was not as large as *komodoensis*. A *komodoensis* maxilla the same length as that of *giganteus* has much larger teeth.

On the basis of the vertebræ and assuming similar proportions, *marathonensis* was two-thirds the size of *komodoensis*. *Priscus*, on the other hand, was one-third or two-fifths larger, and on the basis of the vertebræ would have been 15 feet long. On the basis of the ulna, the longest preserved limb bone of *priscus*, that animal would have been fourteen and a half feet long. It was much more heavily built and must have been almost *Phrynosoma*-like in proportions.

CONCLUSIONS

1. *Varanus komodoensis* is not known to reach a greater length than three meters.
2. Since only males are known to reach over two meters, the chances of a greater length than three meters being attained are small.
3. Of living species, *Varanus varius* of Australia is the most similar.
4. Among the Old World Miocene-Pleistocene fossils, there is similarity in one or another character with *marathonensis*, *dirus*, *emeritus*, and *priscus*. Described and figured remains indicate that *komodoensis* is conspecific with none of these, and definite similarity in characters other than those of weight of vertebræ is only indicated with the last three.

5. Of the fossils, the slimmer *sivalensis* and *emeritus* may have been ten to twelve feet in length. *Dirus* was probably smaller than *komodoensis*: *marathonensis* was about six feet long; *priscus*, which compared to *salvator*, has an estimated length of thirty feet, has, when the more proper comparison to *komodoensis* is made, a length of not more than fifteen feet.

6. Since, in regard to relative tooth size *komodoensis* forms a transition between the normal *giganteus* and the large-toothed *dirus* and *priscus*, and in regard to relative size of neural canal it and *marathonensis* form a transition between the normal type and the very heavy *priscus*, I am disinclined to regard *priscus* as having characters which necessitate generic and much less family distinction. Since the characters on which Camp considers *Saniwa* as of a different subfamily are vertebral and are solely proportional, I prefer to consider it merely generically distinct from *Varanus* on the basis of the characters pointed out by Gilmore.

7. I regard the osseous development of *marathonensis*, *komodoensis*, and *priscus* as extremely possible of independent origin. I therefore place no stress on a possible relationship to *marathonensis* where there are no other similar characters. This does not hold true for *priscus* nor for *dirus*. I regard *komodoensis* as definitely an Australian type derived from an animal much like *varius* and intermediate between it and the two Australian fossil forms.

8. The significance of the preceding conclusions may be expressed as follows: from an ordinary varanoid stock either larger and similar or larger and heavier forms may be produced under certain circumstances. These circumstances obtained in the Pleistocene in Australia. *Varanus komodoensis*, a modern offshoot from an Australian stock, now exists in a certain restricted region in the Lesser Sunda Islands. The Australian element in this region seems to be a reëntrant from the Australian center of evolution (cf. *Cuscus*, a Diprotodont Marsupial, and hence probably a reëntrant, for if a relict from the movement of the early Marsupials into Australia were left in the Lesser Sundas, it would be one of the more primitive Polyprotodonts). Whether *komodoensis* arrived in Komodo in its present state of development and by what route it arrived at its present range are two unanswerable questions. The picture of evolution which presents itself to my own mind is one of ordinary lizards, in an arid country, and free from competition from the higher mammals (Australia in the pre-*Homo sapiens*, pre-*Canis dingo* days), becoming large carnivores or perhaps carrion feeders. One of these, or one of the yet undifferentiated members of the same stock possessing the same potentialities of development, arrived by unknown means in the Lesser Sundas and met the vanguard of the Placentals (Herbivores, as yet, and still, unaccompanied by the higher and larger Carnivores, and as yet unfollowed by man). Here, these Australian emigrants persisted or developed, and here, in the same or in a latterly more restricted range, they can still be found.

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RESULTS OF THE DOUGLAS BURDEN EXPEDITION TO THE ISLAND OF KOMODO

II.—SNAKES FROM THE EAST INDIES¹

BY EMMETT REID DUNN

The snakes mentioned herein were taken by the Douglas Burden Expedition to the Island of Komodo in the summer of 1926. They come from the islands of Java, Bali, Lombok, Komodo, and Wetar, and number twenty species and sixty-six specimens. There are no new species or races, but seven are new to Komodo, and five to Wetar, while Russell's viper, which was taken on Komodo, is new to the Lesser Sundas, and has for a long time been considered not to exist at all in the East Indies.

Typhlops braminus (Daudin).—Three specimens (Nos. 32112–4) from Bali. This very wide-spread form had not previously been taken on Bali.

Typhlops lineatus Boie.—Four specimens from Buitenzorg, Nos. 31953–6.

Liasis mackloti Duméril and Bibron.—Two specimens from Uhak, on the north coast of Wetar, Nos. 32264–5. These make a new record for the island. They have a slightly greater number of scale rows (57–60) than the 49–55 given by de Rooij (1917, 'The Reptiles of the Indo-Australian Archipelago,' II, p. 17) for specimens from Timor, Savu, and Samao. Her largest specimen was 1680 mm. long, but one we had which disintegrated in transit measured 2200 mm. The native name is "sawa," a name also used on Wetar for *Elaphe* and *Lycodon*.

Ptyas korros (Schlegel).—A young specimen, No. 31948, from Buitenzorg. A small specimen of this snake from the same locality served as the type of Barbour's *Liopeltis libertatis* (1910, Proc. Biol. Soc., Washington, XXIII, p. 169). The two descriptions are identical, and many points, especially the two loreals, of *L. libertatis* indicate a very different snake from the other *Liopeltis*. Miss Cochran and Dr. Stej-

¹Contributions from the Department of Zoology, Smith College, No. 144.

neger have kindly examined the type in the National Museum, and assured me that my opinion is correct.

Liopeltis tricolor (Schlegel).—One from Buitenzorg, No. 31951.

Elaphe oxycephala (Boie).—One from Buitenzorg, No. 31946. This specimen has no loreal.

Elaphe subradiata (Schlegel).—Five specimens: one from Komodo, near the coast (No. 31973), and four from Uhak on Wetar (Nos. 32251–4). New record for both islands. Another was seen on Komodo at 2000 feet, half digested by a cobra, which was a good deal smaller than the *Elaphe*. Both from Komodo had four dark lines anteriorly. Those from Wetar had rather irregular dark streaking anteriorly. The Komodo specimen has one preocular, a very large subocular, eight upper labials, and the subocular, the fourth and the fifth upper labials enter the eye. The Wetar specimens have one preocular, no subocular, nine upper labials, and the fourth, fifth, and sixth enter the eye. Obviously, the subocular of the Komodo snake is the same scale as the fourth labial of the Wetar ones. All the Wetar snakes have 23 scale rows and the ventrals are 234–245. The Komodo snake has 25 scale rows and 251 ventrals.

At first sight one might define these as races, but the snake is known from seven other islands. Stripes are known to occur and known to break up elsewhere in the range. De Rooij gives the scale rows as 23–25 and the ventrals as 226–248. The specimen recorded by Boulenger (1897, Ann. Mag. Nat. Hist., (6) XIX, p. 506) from Sumba has the "subocular fused with the fourth upper labial so that three labials enter the eye." The two recorded by Roux (1911, Zool. Jahrb., Abt. Syst., XXX, p. 502) from Lombok have (a) the right subocular much deeper, so that it looks like a supralabial, and (b) the subocular fused with the fourth supralabial, and three labials entering the eye. Consequently, the Wetar snakes have their chief peculiarity repeated in Sumba and in Lombok, and, as a matter of fact, far away to the west in the island of Engano, south of Sumatra, by *Elaphe enganensis*. Practically the only character separating this last from *subradiata* is the presence of three labials entering the eye. I am inclined to doubt whether the distinction between the two can be maintained. At any rate, their presence in these separated regions indicates their age.

Dendrophis formosus Boie.—One specimen from Buitenzorg, No. 31947.

Dendrophis pictus (Gmelin).—Eight specimens from Buitenzorg (No. 31949), Suela on Lombok (No. 31934), Komodo near the coast (No. 31968), Komodo at 2000 feet (No. 31960), and Uhak on Wetar (Nos. 32247–50). It has not previously been recorded from Komodo or Wetar. The lateral stripe seems to die out gradually in the east. The Wetar specimens lack the stripe entirely and belong to Smith's recently described race *Dendrophis pictus timorensis*. One of the Wetar specimens had eaten the only specimen of *Sphenomorphus undulatus* which we met with. The hemipenis of this snake is unforked with unforked sulcus, the basal one-third is longitudinally flounced and set with tiny hooks, about one-fourth is of larger hooks, then comes a fourth of calyces with a free posterior border, and the whole ends with a smooth awn (No. 31949). The calyces have small spines. The native name on Wetar is "sagaloi."

Lycodon aulicus (Linné).—Three from Komodo, near the coast (No. 31967), and from Uhak on Wetar (Nos. 32245–6). It reaches 2000 feet on Komodo, for a piece of one was found in a cobra's stomach at that altitude. It had not been recorded from Komodo. The hemipenis of No. 31967 is single, the sulcus is unforked, proximal half with hooks, distal with flounces. The Komodo specimen was climbing on a tree at night.

Natrix chrysarga (Schlegel).—Three specimens from Tjibodas in Java, Nos. 31939–40.

Natrix subminiata (Schlegel).—Two from Buitenzorg (Nos. 31950–1). In one of these on the left side only two labials enter the eye. In the other there are only seven labials, two entering the eye. Barbour (1912, Mem. Mus. Comp. Zoöl., XLIV, p. 111) has noticed this unusual variation in another Buitenzorg specimen.

Calamaria linnæi Boie.—Two specimens from Tjibodas in Java, Nos. 31942–3. The former had a red, the latter a yellow, belly. The latter had five upper labials, on the left side, the fourth was very small. The hemipenis is calyculate and forked.

Calamaria virgulata Boie.—One specimen from Tjibodas, No. 31944. In this species the hemipenis is calyculate and forked, and there is an apical awn.

Psammodynastes pulverulentus (Boie).—Nine from Tjibodas in Java (4500 ft., No. 31938), Sembalun (3500 feet, Nos. 31932–3, 31937) and Tanganea (5000 feet, No. 31935) on Lombok, and Komodo at 2000 feet (Nos. 31936, 31961–3). The Komodo examples seem slightly paler than the Javanese. This species had not yet been recorded from Komodo.

The hemipenis is forked and so is the sulcus, hooked throughout. On the distal half the hooks are in close-set flounces.

Homalopsis buccata (Linné).—One specimen from Buitonzorg, No. 31945.

Naja naia sputatrix (Boie).—Five specimens from Komodo; three from sea-level (Nos. 31957–9) and two from 2000 feet (Nos. 31974–5). At least two others were seen. One had eaten a *Lycodon aulicus*, and one an *Elaphe subradiata*. They had feebly developed hoods which they seldom spread.

I use the Javanese racial name for this easternmost cobra, already recorded from Lombok, Sumbawa, Flores and Alor. Not hitherto taken on Komodo. Javanese cobras have ventrals 163–183. Our five have 170–177. In the matter of marking and color, all were dull brown; three had faint dark bars across the throat; the hood marking varied from merely two light dots on the skin to a light V on the scales. This is the coloration and ventral count of *sputatrix*, as given by Barbour (1912). The number of scale rows was in three, 21 on neck and 19 on body, and in two, 23 on neck and 19 on body. Javanese cobras have usually 25 on neck and 21 on body, but the range on the neck is 25–23, and on the body, 19–23. Roux (1911) had one from Sumbawa and one from Lombok. These had 23 on the neck and 19 on the body. Boulenger (1897) had one from Flores with 21 on the neck and 19 on the body. The Lesser Sunda cobra has then in eight specimens the color and ventral count of Javanese cobras. It apparently always has 19 scale rows on the body, while about 80 per cent of Javanese cobras have 21–23, and only 20 per cent have 19. It has equally 21 or 23 rows on the neck, while Javanese never have 21 and rarely 23. But only half the specimens could be absolutely distinguished apart from locality, and I am opposed on principle to the recognition of local races unless the great majority of one race is outside the range of variation of the other.

Laticauda colubrina (Schneider).—One specimen from Uhak on Wetar, No. 32244, not hitherto recorded from the coast of this island.

Vipera russellii (Shaw).—Two from Komodo (Nos. 31971–2). Not hitherto recorded from this island. These two specimens of Russell's viper have been carefully compared with specimens from India, kindly loaned me by Dr. Barbour, and found not to differ. They have 29 scale rows and 154 ventrals. Both Duméril and Bibron (1854, *Erp. Gén.*, VII, p. 1435) and Boulenger (1896, '*Cat. Sn. Brit. Mus. Nat. Hist.*,'

III, p. 490) have recorded each a single specimen from Java. Ditmars (1910, 'Reptiles of the World,' p. 323) mentions some from Sumatra collected by Mr. Rudolf Weber. The snake is not known from the Malay Peninsula and no recent specimens are known from Java, so that de Rooij was inclined to doubt the earlier records. Now, however, they appear more plausible, although it is very remarkable to find a true viper so far east. They were taken in the lower hills of the island.

Trimeresurus gramineus fasciatus (Boulenger).—Thirteen specimens from Komodo (sea-level, Nos. 31969–70), (2000 feet, Nos. 31964–6) and Uhak on Wetar (Nos. 32257–61). They were very common at Uhak and several more were seen. One of those taken at sea-level on Komodo had eaten a mouse, and two from 2000 feet had eaten *Kaloula pulchra*. It had not previously been recorded from Komodo or Wetar.

I have examined a number of other specimens of this snake from Chekiang, Formosa, Hainan, Siam, Java, and India. The last is the type locality and these specimens (Mus. Comp. Zoöl., No. 4490 "India") may be taken as the true *gramineus*. There are apparently two intergrading races. One is represented by the specimens from Chekiang and Formosa. Specimens from India and Siam are intermediate between it and the other which includes those from Hainan, Java, Komodo, and Wetar. In the former, the nasal and the first labial are completely separate, and there is one (occasionally two) well-developed loreal. In specimens from India and Siam the nasal and the first labial are incompletely fused, and the loreal is rudimentary. In the rest there is no loreal and the nasal and first labial are completely fused. This situation has recently been treated by Werner (1924, Sitz. Akad. Wiss. Wien, I, 133, p. 47) who regards the northern race as true *gramineus*, and the southern as *fasciatus* Boulenger, described from Djampéa Island, south of Celebes. This is open to two criticisms: first, if races are to be recognized at all, the northern as well as the southern must be named and the term *gramineus* restricted to the intermediates; second, *fasciatus* was described as having quite large supraoculars, in opposition to the small size of these plates in *gramineus*. De Rooij seems to have seen the type of *fasciatus* and recognizes it as distinct. Werner seems not to have seen it, but claims the character lacks significance. I am inclined to think that he may be right and therefore prefer not to name the southern race myself. Schmidt (1925, Amer. Mus. Novit., No. 157, p. 4) has given two names to Chinese specimens. His *stejnegeri*, from Fukien, I am inclined to believe the same as the Chekiang and Formosan form,

although his character of the separated chin plates (also a character of his *yunnanensis*) I have seen in no *gramineus*. Like Werner, he ignores the question of the identity of true *gramineus*. The forms then stand as *stejnegeri* with separated supranasals, separated nasal and first labial, and with a loreal; *yunnanensis* with lower scale count, otherwise like *stejnegeri*; *gramineus* with rudimentary loreal, supranasals separated by one scale, and partially fused nasal and first labial, from Siam and India; and a southeastern form, for which the name *fasciatus* is quite likely available, which I have seen from Hainan, and Werner from Assam, and which probably inhabits the islands of the East Indies (Werner mentions Sumba, and I have seen it from Java, Komodo, and Wetar).

Further characters of this race are that all from Komodo and Wetar have 21 scale rows and the supranasals in contact.

The native name on Wetar is "oily."

REMARKS

Of the eight species of terrestrial snakes taken on the course of the expedition on the islands east of Wallace's Line, seven show Asiatic affinities and one (*Liasis mackloti*) Australian. Of the seven Asiatics, one (*Elaphe subradiata*) is not known from west of Wallace's Line, and this form is so like *Elaphe enganensis* of Engano Island, south of Sumatra, that it appears less like an endemic Lesser Sunda form than a relict form of an earlier fauna, now lingering in two very slightly differentiated species in the Lesser Sundas and in Engano. The *Liasis*, found on Wetar for the first time, was already known from Savu, Samao, and Timor, and is very slightly different from Australian and Papuan species. The headquarters of the genus is eastwards, however, and the genus marks as clearly an Australian element in the snake fauna of Wetar as the species of *Lycodon*, *Dendrophis*, *Elaphe*, and *Lachesis* on the same easternmost island of the chain indicate an even stronger Asiatic element. The one Australian type found is distinct, as is only one out of seven of the Asiatics.

Of the thirty-three terrestrial snake species known from the Lesser Sundas ten are restricted to these islands. Of these, four, *Liasis mackloti*, *Python timoriensis*, *Typhlops elberti*, and *Typhlops florensis* may well be eastern. Three have definite western affinities and three, while as definitely western in their affinities, have more alliance with an endemic or an earlier fauna which may be found in the Moluccas or in Celebes. This last element does not necessarily mean migration to or from these regions to the Lesser Sundas. More probably this series of forms passed

out from Asia along a northern and a southern route. Whatever may have been the means of migration, it has been much easier for snakes to get from Asia to Wetar, more than a thousand miles of sea and islands, than from Cuba to Haiti over a strait of fifty miles. Four snakes are known in common from the first two (out of seven species known from Wetar), while only one species of snake is common to Cuba and Haiti, although each island has about twelve species.

Of the forms not restricted to the Lesser Sundas, four seem definitely eastern, one Moluccan and eighteen western.

Thus, there is a great difference in the quality of the emigration. Over half the snake fauna has come over unchanged from the west, and only three of this group have changed. Of the eight easterners four have undergone modification. The slight trace of an endemic or a Moluccan element consists of three species restricted to the region, and one more wide ranging (*Brachyorrhus albus*), and all are definitely western in their larger affinities.

This seems to indicate an overwhelming modern unmodified Asiatic element, a small and rather modified Australian element, and a minute and modified old Asiatic element. For mammals, of course, this situation is well known to exist in the East Indies, with the old Asiatic element best marked in Celebes.

The eastern element is naturally strongest in the more eastern islands, although of the species considered eastern, one occurs on Lombok, and two on Flores. The snakes of the eastern-most isolated island of Wetar are six out of seven western types, and only one of them is modified (*Cylindrophis boulengeri*).

The difference in island speciation to be found in the same group in the East Indies and in the West Indies, has, of course, nothing to do with the provenance of the fauna. The chief difference between the islands on which these phenomena are most marked is that the Greater Antilles are nonvolcanic, while the Sundas are noted for the number and activity of their volcanoes. The correlation is sufficiently obvious. It would seem that migration from island to island is easier when these islands are volcanic in nature.

A point of interest is the high proportion of venomous individuals and species on Komodo. Of the seven species, three were harmless, one slightly poisonous, and three very poisonous. Of twenty-five specimens seen there, seven were cobras, five tree-vipers, two Russell's vipers, and four the opisthoglyph *Psammodynastes*, while only seven individuals of the three harmless species were met with.

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RESULTS OF THE DOUGLAS BURDEN EXPEDITION TO THE ISLAND OF KOMODO

III.—LIZARDS FROM THE EAST INDIES¹

BY EMMETT REID DUNN

The lizards which form the subject of this paper were taken by the Douglas Burden Expedition to the Island of Komodo in the summer of 1926. They come from the islands of Pulo Weh (north of Sumatra), Java, Bali, Lombok, Komodo, Padar, and Wetar. There are two hundred and forty-nine specimens which comprise twenty-seven species and three subspecies. There are four new species and three new races in the collection. A number are, of course, new to the island concerned, and these will hereinafter be designated as such.

Gymnodactylus defosseii, new species

DIAGNOSIS.—A *Gymnodactylus* with no femoral or preanal pores; lateral fold of conical tubercles; dorsal tubercles very large; ventral scales small, 42 rows, smooth; tail with whorls of tubercles.

TYPE.—A. M. N. H. No. 32108; Komodo, at sea-level; collected June 19, 1926. Paratypes, Komodo, 2000 feet, 11 specimens (Nos. 32033–43).

RANGE.—Komodo, from sea-level to 2000 feet.

DESCRIPTION.—A. M. N. H. No. 32108; adult male; head large, depressed; snout one and one-half times the diameter of the orbit; orbit less than its distance from the ear; forehead concave; ear a vertical oval, three-fourths the diameter of the orbit; head covered with granules, largest on snout; scattered, smooth, conical granules on the occiput; rostral broader than high, bordered above by three scales, and with a median cleft; nostril bordered by rostral, first labial, supranasal, supranasal, and one or two granules; labials $\frac{10}{16}$; mental triangular; one pair of chin shields meeting behind mental; dorsal surface covered with granules and with 17 rows of large, trihedral, three-keeled tubercles; ventrals small, imbricate, smooth, in 42 rows across belly; no femoral or preanal pores; lateral fold with some enlarged and conical tubercles; (tails of A. M. N. H. Nos. 32035–6 cylindrical; granular above; enlarged scales below; proximal two-thirds with whorls of six enlarged tubercles); arm with small tubercles; leg with granules and large tubercles; grayish brown above; about six darker chevrons across body; the first is occipital and is a continuation of the post-ocular bar; (the color may be light gray with a few scattered dark spots; tail with equal rings of black and gray); head and body 85 mm.

¹Contributions from the Department of Zoology, Smith College, No. 145.

The type is the largest specimen and the only one taken in the low country. It was taken at night on a tree close to the hut which I shared with M. F. J. Defosse. He was with me when I secured the specimen and I am associating his name with it. The species was extremely common on the great rocks of the forest at 2000 feet altitude. Its relationships are somewhat to seek. The particular features of this species are large tubercles on the dorsal region, and complete lack of femoral or preanal pores. These two characters are not found together in any of the species whose descriptions are accessible to me, and certainly in none from the East Indies. The large tubercles are found in *d'armandvillei* from Flores and in the new species from Wetar, and possibly in the oceanic *pelagicus*. Two, *jellesmae* and *sermowaiensis*, from Celebes and New Guinea respectively, lack pores, but neither have the enlarged regular tubercles. The Wetar form has pores.

***Gymnodactylus wetariensis*, new species**

DIAGNOSIS.—A *Gymnodactylus* with 12–13 femoral pores on each side; 11 preanal pores in an angular series; lateral fold of flat tubercles; dorsal tubercles very large; ventral scales in 38 rows; tail with whorls of tubercles.

TYPE.—A. M. N. H. No. 32165. Paratypes Nos. 32160–4; collected July, 1926

TYPE LOCALITY.—Near Uhak, on the north coast of Wetar.

RANGE.—Known only from the type locality.

DESCRIPTION.—A. M. N. H. No. 32165; adult male; head medium, depressed; snout one and one-third times the diameter of orbit; orbit equals its distance from the ear opening; latter oblique, one-fifth the diameter of the orbit; forehead concave; head with granules, largest on snout, small tubercles on occiput; nostral broader than high, bordered above by three granules and with a median cleft in the upper part; nostril bordered by the rostral, first labial, postrostral, supranasal and postnasal; labials $1\frac{1}{2}$; mental triangular; a pair of chin shields meeting behind mental; throat granular; body with granules and with 14–16 series of large trihedral tubercles; lateral fold with enlarged flat or rounded tubercles; ventrals imbricate, smooth, in 38 rows; an angular series of 11 preanal pores, separated by an interspace from the femoral pores which are 12–13 on a side; tail (of No. 32162) terete, uniform granules larger below, whorls of four tubercles on basal part; arms with granules and small tubercles; legs with tubercles the size of those of the back; blackish or gray above with irregular transverse markings of darker; a dark curved mark from one eye back and across occiput to the other eye; a dark line from eye to shoulder; head and body 70 mm.

These lizards, called, as is Gekko, “tekke” by the natives, were taken both at night and in the daytime on trees. Their relationships are, so far as the scalation is concerned, with *d'armandvillei* of Flores and with *defosseii* of Komodo. With regard to the femoral and preanal pores, *defosseii* with none at all is quite different, while *d'armandvillei* with 18–19

femorals and no preanals is sufficiently distinct. Those having similar pores in the East Indies are *marmoratus*, widely distributed, with 12-13 preanals and 4-5 femorals; *baluensis*, from Borneo, with 9-10 preanals, and 6-9 femorals; and *mimikanus*, from Papua, with 7-14 preanals and 10-12 femorals. Of these, *marmoratus* and *baluensis* have much smaller dorsal tubercles, but much the same coloration; *mimikanus* has a very different set of markings, and the tubercles, while in regular rows, are smaller.

Hemidactylus frenatus Duméril and Bibron

Eight specimens: Komodo at sea-level (Nos. 31205-7); Komodo at 2000 feet (Nos. 31995-6); Padar (Nos. 32018-9); Wetar (No. 32119). It was seen also in Lombok at Sembalun, and in Java at Buitenzorg. New to Komodo and to Padar.

Cosymbotus platyurus (Schneider)

One specimen from Buitenzorg (No. 31998).

Peropus mutilatus (Weigmann)

Two specimens: Komodo at 2000 feet (No. 31997); Wetar (No. 32150). New to both islands.

Gekko gecko (Linnaeus)

Ten specimens: Komodo at sea-level (Nos. 31209-10); Komodo at 2000 feet (Nos. 32048-9); and Wetar (No. 32226-31). It was also heard on Sangeang off the northwest point of Sumbawa, and at Buitenzorg. New to all three islands.

Draco volans Linnaeus

Three specimens: Buitenzorg (No. 32020), and Bali (Nos. 32118-9).

Draco reticulatus Günther

Two specimens from Komodo at sea-level (Nos. 32094-5). New to the island.

Draco timorensis Kuhl

One specimen from Wetar (No. 32151). Native name "tokkai."

Aphaniotis acutirostris Modigliani

Three specimens from Pulo Weh (Nos. 32029-31).

Gonyocephalus chamaeleontinus (Laurenti)

Five specimens from Tjibodas (Nos. 32024-8). *G. kuhli* (Schlegel) is clearly a synonym.

Dendragama fruhstorferi Boettger

Three specimens from Tjibodas (Nos. 32021-3).

Varanus salvator (Laurenti)

One specimen from Bali. A specimen was seen at Suela, in Lombok.

Varanus komodoensis Ouwens

This lizard was the main object of the expedition and a discussion of its relationships forms the subject of a separate paper (No. 1 of this series, Novit. No. 286). The number of specimens taken was limited by the Colonial Government, which in 1915 declared its range closed to hunting. Despite a certain amount of poaching in the early part of 1926, these lizards are fairly common on Komodo. We saw tracks on Padar, whence they had not been recorded. It is very decidedly an Australian type.

Mabuia multifasciata (Kuhl)

Thirteen specimens as follows: Tjibodas (Nos. 31976, 32044-7); Bali (Nos. 32115-7); Sajong on Lombok (No. 31999); Komodo at sea-level (No. 32096); Komodo at 2000 feet (Nos. 31991-3). Not hitherto known from Bali or Komodo.

Sphenomorphus florensis (M. Weber)

Of this species I have seen the following specimens: Komodo, sea-level, 8 (Nos. 32097-104); Komodo, 2000 feet, 21 (Nos. 32050-70); Padar, 5 (Nos. 32000-4); Flores, 1 (Mus. Comp. Zoöl., No. 9319); Wetar, 18 (Nos. 32187-204); Damma, 1 (Mus. Comp. Zoöl., No. 2099).

These specimens are divisible into four local races on the basis of coloration. The single specimen from Flores is a young one and so like small specimens from Padar that I cannot separate the two. But all from Komodo can easily be told from those from Padar or Wetar. The Damma specimen is quite different. The species has not previously been recorded from Komodo or Padar. I find no differences in scalation. These races may be diagnosed as follows.

Sphenomorphus florensis nitidus, new subspecies

DIAGNOSIS.—Young: brilliantly marked with a light and a dark dorso-lateral streak extending onto tail; a dark streak in front of groin; a very faint mid-dorsal light streak; dorsal spotting very faint and irregular. Medium: dark dorso-lateral stripe distinct only anteriorly; dorsal spots nearly invisible. Adult: almost without markings; top of head darker than sides with a dark line of demarcation; head not red; no black on throat; no post tympanic marking.

TYPE.—A. M. N. H. No. 32068. Paratypes, 28 specimens (Nos. 32097-104, 32050-67, 32069-70).

TYPE LOCALITY.—Komodo, 2000 feet altitude.

RANGE.—Komodo, sea-level to 2000 feet.

Sphenomorphus florensis florensis (Weber)

DIAGNOSIS.—Young: a light dorso-lateral stripe, but dark dorso-lateral stripe indistinct and broken; no dark streak in front of groin; a prominent mid-dorsal light stripe; dorsal spots large and distinct. Medium: dark dorso-lateral stripe broken; mid-dorsal stripe prominent; dorsal spots large. Adult: almost without markings; top and sides of head same color, no line of demarcation on sides of head; head with reddish tinge; throat flecked with black; no post-tympanic mark.

RANGE.—Padar and Flores.

Although amply distinct in both young and adult from the specimens of Komodo on the other side of the narrow but deep and swift Linta Straits, I have been unable to find any characters to separate young from Padar from a young specimen from Flores, the type locality. I am, however, inclined to think that such characters exist, for de Rooij's description, presumably drawn from adults from Flores, does not agree very well with any adults I have seen from anywhere (1915, Rept. Indo-Australian Arch., I, p. 173, Fig. 71). As in many other cases, more material is necessary before this problem can be settled.

Sphenomorphus florensis barbouri, new subspecies

DIAGNOSIS.—Young: no light dorso-lateral line; dark dorso-lateral line only distinct anteriorly; no striping on tail; a marked mid-dorsal light stripe; streak in front of groin very indistinct; small dorsal spots. Medium: much the same as young, but dorso-lateral stripe fainter. Adult: dorso-lateral stripe not apparent; mid-dorsal stripe persistent; a light and a dark post-tympanic streak; throat black.

TYPE.—A. M. N. H. No. 32203. PARATYPES, 17 specimens, Nos. 32187 202, 32204.

TYPE LOCALITY.—North coast of Wetar, near Uhak.

RANGE.—Island of Wetar.

Named in honor of Dr. Thomas Barbour, who lent me material of this species, and who was the first to recognize insular races of lizards in this region. The native name is "tulupuhu."

Sphenomorphus undulatus (Peters and Doria)

A single specimen taken from the stomach of a *Dendrophis* on Wetar, No. 32206. This is certainly different from the series called *S. emigrans* in the preceding paragraphs, but I am by no means sure that it is *undulatus*. It has 30 scale rows, the mid-dorsal half again as wide as the rest; prefrontals in contact, right fused with frontal; 20 subdigital lamellæ under the fourth toe; 5 supraoculars; 5 nuchals on one side and 6 on the other; the frontal is wider than the supraocular region, and the legs are short. The color is brown; some scales light and some dark; occasionally a light scale has a quite dark anterior border; this gives the effect of very narrow, indefinite, wavy cross-bands. It differs from the description of *undulatus* in having two more scale rows and more nuchals. The next closest species is *aruanus* from the Aru Islands. This differs from *undulatus* and from the Wetar specimens in having fewer subdigital lamellæ, as well as in color. *Undulatus* has previously been recorded from Ceram, the Kei Islands, and Papua.

Dasia smaragdinum elberti (Sternfeld)

Seven specimens from the north coast of Wetar (Nos. 32219–25). Scale rows 26–28. In color there is much variation: one was bright green on the sides as far as the groin, and above as far as the middle of the back, while the hinder part of the body was brown with black dots; another was similar, but the dots on the brown portion were a combination of black and white; two were brown with the black and white dots and a green tinge to the head and neck; two others were brown with spots all over and no trace of green. I saw no evidence that they changed color. This race has, as Sternfeld (1920, Abh. Senckenbergische Nat. Ges., XXXVI, p. 401) pointed out, the color of specimens from the Moluccas, but a higher scale count. He had only one specimen, collected by Elbert at Iliwaki on the south coast. This had 27 scale rows. Two of ours have 26; two, 27; and three, 28. The six I collected were all on tree trunks. The native name is “ular moin.”

Homolepida temminckii (Duméril and Bibron)

Twelve specimens from Tjibodas (Nos. 31979–90). No. 31981 has the prefrontals in contact and 30 scale rows.

Homolepida schlegeli, new species

DIAGNOSIS.—A *Homolepida* with 22 smooth scales, fourth toe longer than third and with 10 subdigital lamellæ; preanals enlarged.

TYPE.—A. M. N. H. No. 31994; collected June 26, 1926.

TYPE LOCALITY.—Komodo, 2000 feet altitude.

DESCRIPTION.—Snout short and blunt; lower eyelid scaly; ear opening round, nearly as large as eye opening; nostril in nasal; no supranasal; frontonasal broader than long, in contact with rostral; prefrontals in contact; frontal shorter than frontoparietals and interparietal together, in contact with 2 supraoculars; four supraoculars, third largest; six supraciliaries; frontoparietal and interparietal equal; parietals in contact; no nuchals; fourth labial below eye; body long, distance from snout to arm contained twice in that from axilla to groin; 22 smooth scales round the middle; preanals enlarged; tail not as thick as body, longer than head and body; limbs short; hind limb as long as from eye to fore limb; digits short; fourth toe longer than third, with ten smooth lamellæ below; a golden brown dorsal stripe four scales wide, bordered by a lighter streak and a dark line on one scale row; flanks grayish brown; white below; dark dots on chin and ventrum of tail; length of head and body 32, tail 40.

Only a single specimen of this species was taken. It was on the ground in the heavy forest, interspersed with great rock masses which form the elevated center of Komodo. It is allied to *crassicauda* and *forbesi*, both of Papua. The former has more subdigital lamellæ, and the latter more scale rows. *H. temminckii* has been recorded from Samao in the Lesser Sundas, and I took it at Tjibodas in Java. It has many more scale rows, and the fourth toe is shorter, although it has the same number of lamellæ. I thought it appropriate to associate the name of Schlegel with this species, since the name of Temminck is already associated with the Sudanese form.

***Leiolopisma fuscum* (Duméril and Bibron)**

Twenty-one specimens from the north coast of Wetar (Nos. 32166-8), where the natives called them "diahna," a name which also includes the short-legged *Sphenomorphus emigrans* and *undulatus*, and *Cryptoblepharus*. It had not previously been recorded from Wetar.

***Emoia similis*, new species**

DIAGNOSIS.—An *Emoia* with short legs, barely meeting when appressed; interparietal fused; frontal longer than prefrontal; 22 lamellæ under fourth toe; 28 smooth scales around body; allied to *cyanurum* and *kordoanum* but with shorter legs.

TYPE.—A. M. N. H. No. 31977.

TYPE LOCALITY.—Komodo, about 500-1500 feet altitude; collected June, 1926.

DESCRIPTION.—A. M. N. H. No. 31978; snout pointed; lower eyelid with a transparent disk; ear opening oval, about as large as the palpebral disk, with 2-3 very short lobules anteriorly; nostril between nasal, postnasal and supranasal; frontonasal broader than long in contact with rostral and with frontal; latter shorter than frontoparietal, in contact with two supraoculars; four supraoculars; five supraciliaries;

frontoparietal single; no interparietal; parietals in contact; a pair of nuchals and a pair of temporals; fifth labial under eye; 28 smooth, equal scales around middle of body; snout to fore limb and one and one-third in axilla to groin; preanals enlarged; tail broken; limbs weak, barely meeting when appressed, digits short, fourth toe with 22 smooth lamellæ below; black, whitish below; light yellow stripes on edges of two adjacent scale rows, one mid-dorsal, from occiput onto tail; one on each side from rostral over supraciliary onto tail; one on each side from axilla to groin; tail blue; length of head and body 31 mm., tail 20.

A second specimen, No. 31977, had head and body 28, tail 51.

These two lizards were taken on open grassy slopes, such as are found on Komodo from sea-level to over 2000 feet. None were seen in the flat coastal grasslands, nor on the higher reaches of the hills. One was taken June 10, and another June 19. On the second occasion I climbed to about 1500 feet and the *Emoia* was taken "high up." These tiny lizards live in tall grass growing among loose stones, and are quite agile, so that the small number collected is no criterion of their rarity in their particular habitat.

This species fits rather in the genus *Riopa*, because of short limbs and enlarged preanals, but it has no obvious relatives in that group and is equally obviously close to *Emoia lessonii* (kordoanum) and to *E. cyanurum*. Its color is exactly that of *cyanurum* (cf. Sternfeld, 1920, Abh. Senckenbergische Nat. Ges., XXXVI, p. 407 and Parker, 1925, Ann. Mag. Nat. Hist., (9) XV, p. 298), while in *lessonii* the mid-dorsal stripe stops at the base of the tail. It has shorter limbs than either with fewer subdigital lamellæ, 22 as against the 33-51 of *lessonii* or the 56-80 of *cyanurum*, and the preanals are enlarged.

It seems at present to be within the range of *lessonii* which extends from the New Hebrides west to Borneo and Java, and is recorded from Samao, Timor, and Gr. Bastaard (Pulo Besar) north off Flores in Lesser Sundas. Some or all of these last localities may refer to the present form, since de Rooij's records do not discriminate between *lessonii* and *cyanurum*, and Sternfeld did not deal with the animals west of the Moluccas. Bornean specimens collected by H. C. Raven and kindly lent me by Dr. Stejneger are obviously *lessonii* (U. S. N. M. No. 51671, Borneo; 51691-7, 52976-83, Pulo Derawan, Borneo).

***Riopa bowringi* (Günther)**

One specimen, No. 32032, from Pulo Weh. The scales are almost smooth. New to the island.

***Cryptoblepharus boutonii furcata* (M. Weber)**

Eight specimens, Nos. 32152-9, from the north coast of Wetar. They have been compared with Mus. Comp. Zool. Nos. 2094-5, from Larantaka, E. Flores, kindly lent me by Dr. Barbour, and found to agree. Flores is the type locality for this form. The specimens were taken in the woods, either on the ground or climbing about in the trees. Five had 24, and three 26 scale rows. New to the island.

***Cryptoblepharus boutonii burdeni*, new subspecies**

DIAGNOSIS.—Differs from the other races of *C. boutonii* in the higher number of scale rows (30-34), and in lacking any trace of light striping. The four median rows of dorsal scales are enlarged.

TYPE.—A. M. N. H. No. 32006. Paratypes Nos. 32004-5, 32007-17; collected July 7, 1926.

TYPE LOCALITY.—Padar, east coast.

RANGE.—Known only from the type locality.

DESCRIPTION.—Scale rows 30-34 (fourteen specimens had 30 rows in four, 32 in five, and 34 in five); no postnasal (a groove in the nasal gives a false appearance of a postnasal); postfrontals in contact; first loreal high, second low and long; four superciliaries; four supraoculars; two of the latter in contact with the frontal, upper eyelid consisting of three scales; bronze color, with obscure darker dots; largest specimen (No. 32006), head and body 47 mm.

VARIATION.—Nearly all the specimens conformed to the above description. No. 32009 had the right prefrontal fused with the frontal; No. 32017 had the two prefrontals fused.

HABITS.—These lizards were discovered by Mr. Burden on rocks at the tide line on the east coast of Padar. Later I observed them there in great numbers, playing about on the wet rocks. So numerous were they that when I had but one 22 shot shell left, I waited until three came close enough to each other and got them all with a single shot. On the wave-cut bench of rock, beset with small pools, and alive with *Periophthalmus* and crabs of various kinds, and wet by the waves of the rising tide, these tiny lizards scuttled about unconcerned by their larger neighbors. When I tried to catch some with my hands they ran into the water of the pools and two were caught there, clinging under water to the rocks.

Sternfeld (1920, Abh. Senckenbergische Nat. Ges., XXXVI, p. 420) has an extensive review of the races of *Cryptoblepharus boutonii*. He regards *peroni* from the Aru and Kei islands as a distinct species. In this I am unable to follow him as the combination of a low loreal and a low scale count in *peroni* and a high loreal and a high scale count in *boutonii* breaks down in the present form which has a low loreal and a high scale count. I follow custom in considering the forms of *boutonii* subspecies. Certainly this one from Padar is in color, scale count, and habits, very different from *furcata* from Flores and Wetar, the only othe

form I have had a chance to observe. It seems really closer to the Polynesian *pacilopleurus*. None of the others from the Lesser Sundas have more than 26 scale rows and all are vividly striped. The type, *boutonii*, which I have not seen, had 26-28 scale rows, an indistinct stripe, and came from Mauritius.

Perhaps there are really two types in this series, a form with many stripes and low scale count, living inland; and a form with no stripe or single lateral stripe, with a high scale count, living on the coastal rocks. I am unable to clear up the matter on account of lack of material.

***Dibamus novæ-guinæ* Duméril and Bibron**

Twelve specimens from Uhak, on the north coast of Wetar, Nos. 32232-43. Not hitherto recorded from Wetar. The native name is "tuhuopun."

GENERAL REMARKS

Disregarding races there are now known from the Lesser Sundas thirty-four species of lizards. Of this number we met with twenty, a much larger proportion than the eight out of thirty-three snakes, which bears out the general experience of collectors as to the uncertainty of snake catching.

Of the Lesser Sunda lizards twelve are apparently restricted to these islands. Of these the three species of *Gymnodactylus* offer no clue as to their provenance. Of the residuum, one is western, one is likewise western in remote origin, but conveys an impression of Moluccan or Celebesian affinities, while seven are eastern.

Of the non-restricted twenty-two, three are noncommittal, eight western, two Celebesian, and eight eastern.

There is thus practically the same situation in lizards as in snakes with regard to the derivation of the endemics. With regard to the non-endemic lizards there are as many eastern as western forms, while in the snakes there are more than four times as many westerners as Australians.

Two factors seem to take part in producing this phenomenon, which is essentially that entrance into and survival in the Lesser Sundas has been relatively easier for eastern lizards than for eastern snakes. One factor is the greater relative migratory capacity of lizards (cf. the wide insular range of many forms, and the fact that from many islands lizards are known, but no snakes.) The second is the climatic character of the Lesser Sundas, where the long severe dry season produces much open country and scanty forest. This condition is, I believe, more favorable

for eastern than for western lizards. It is also more favorable for eastern than for western snakes, on the same line of reasoning, but eastern snakes, with their less capacity for extending their ranges have not been able to take advantage of it. An example is *Calotes cristatellus* which has gotten as far as Papua, but which is absent from the Lesser Sundas. Obviously, the explanation of its absence is not that it has been unable to reach these islands, but that the conditions are unsuited to it.

At any rate, whatever the explanation, slightly over one-fourth the lizard fauna has come from the west. About one-fifth of these have been modified. Slightly under half have come from the east and nearly half of these have changed. Thus the relative proportion of endemics in the two faunal groups is about the same in the lizards as in the snakes, and indicates a more difficult route from the east in both cases. There is, as in the snakes, a minute and largely modified old western element.

In this group there is the largest element of unchanged eastern types in the herpetological fauna, but it does not exceed one-fourth of the total. Even here where the eastern element is most highly marked, the Lesser Sundas are faunally nearly as much Asiatic as Australian, while in the snakes and frogs the fauna is overwhelmingly Asiatic. In these groups, then, Wallace's line is in no sense a faunal boundary.

At least three of the eastern types reach Java, although the three next to appear are found in Komodo. Wetar, far to the east and uncommonly isolated, has a fauna of fourteen lizards. Of these five are western, five eastern, one of the middle fauna, and three non-committal. One species and two races seem restricted to it. Remarkable on this isolated island are the number of burrowing forms, four lizards and a snake. Three are from the east and two from the west, and they are the last animals one would expect to find there. The snake is peculiar to the island, but the lizards are widespread forms.

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THE SKULL CHARACTERS OF *CROCODILUS MEGARHINUS* ANDREWS¹

BY CHARLES C. MOOK

INTRODUCTORY REMARKS

The species *Crocodylus megarhinus* was based by Andrews, in 1905, upon an incomplete rostrum (Brit. Mus. No. R.3327).² This specimen, though incomplete, exhibits distinctive characters. The length of the expanded rostrum, anterior to the normal crocodilian constriction, is considerable in proportion to its breadth. Its breadth, however, is great, making this anterior process of relatively large size. The large external narial aperture is located entirely within this process of the rostrum, and does not extend backward beyond the level of the constriction as in *C. niloticus* and other species of the same general proportions. Andrews described this material more fully, and figured it in 1906.³ Recently more complete material has been described by L. Müller.⁴

In the American Museum Fayûm Collection of 1907 is a well-preserved skull, which is clearly referable to *Crocodylus megarhinus*. This skull (Amer. Mus. No. 5061) from the lower beds of the Fluvio-marine formation, of upper Eocene age, near Birket-el-Qurun, Fayûm, Egypt, is nearly perfect, and permits the description of many characters of the species which were not preserved in the type. The following description is based upon this skull and upon a large mandible which is probably referable to this species (Amer. Mus. 5095).

GENERAL FORM

In its general form the skull is relatively short, broad, and stoutly constricted, resembling somewhat the skull of *C. niloticus*. The proportion of the length of the snout anterior to the orbits, to its breadth at the level of the anterior ends of the orbits, is exactly the same as in *C. niloticus*. The snout occupies a somewhat greater proportion of the total length of the skull in the present species, however, than in *C. niloticus*, the preorbital region being shorter.

¹Contributions to the Osteology, Affinities, and Distribution of the Crocodilia, No. 18.

²Andrews, C. W., 1905, 'Notes on some New Crocodilia from the Eocene of Egypt,' Geol. Mag., N.S., II, Dec. 5, pp. 481-484 (482).

³Andrews, C. W., 1906, 'A Descriptive Catalogue of the Tertiary Vertebrata of the Fayûm, Egypt,' Brit. Mus. Nat. Hist., pp. 264-266, text-fig. 85.

⁴Müller, Lorenz, 1927, 'Ergebnisse der Forschungsreisen Prof. E. Stromers in den Wüsten Ägyptens. V. Tertiäre Wirbeltiere. 1. Beiträge zur Kenntnis der Krokodilier des ägyptischen Tertiärs,' Abhandl. d. Bayerischen Akad. d. Wissensch. Matem.-naturw. Abt., XXXI, 2 Abh. pp. 1-96, 3 pls. (pp. 59-66, 81, p. 2, figs. 5a, 5b, 5c, 5d).

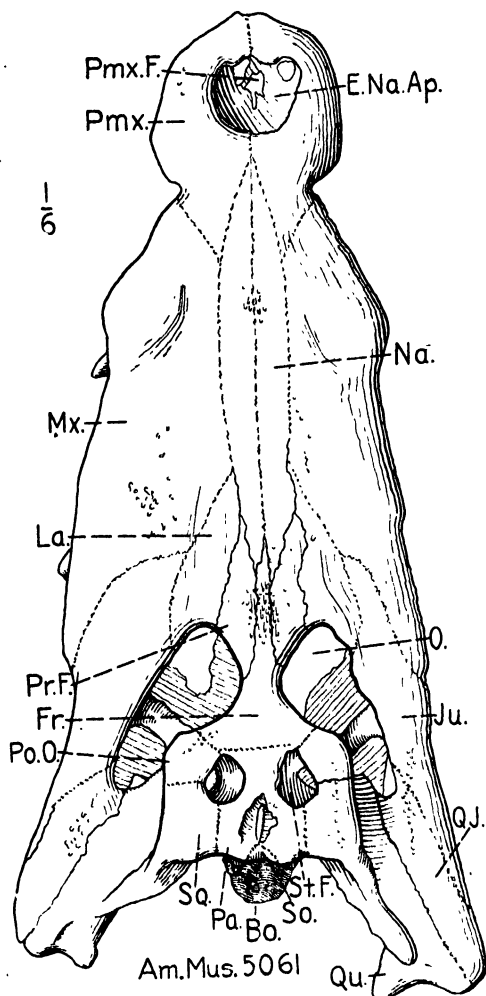


Fig. 1. *Crocodilus megarhinus* Andrews. Skull (Amer. Mus. 5061). Fluvio-marine Beds of Upper Eocene age, near Birket-el-Qurun, Fayûm, Egypt One-sixth natural size.

Superior view. Bo., basioccipital; E. Na. Ap., external narial aperture; Fr., frontal; Ju., jugal; La., lacrymal; Mx., maxillary; Na., nasal; O., orbit; Pa., parietal; Pmx., premaxillary; Pmx. F., premaxillary foramen; Po. O., postorbital; Pr. F., prefrontal; QJ., quadratojugal; Qu., quadrate; Sq., squamosal; St. F., supratemporal fenestra.

The cranial table is small. A comparison of its measurements in any direction shows it to be considerably smaller in proportion to other dimensions of the skull than in *C. niloticus*. The lateral borders converge more sharply forward than do those in the latter species.

The festooning of the lateral border of the skull, viewed from the side, is considerable, but its extent cannot be determined accurately, owing to a certain amount of distortion in the specimen.

The constriction at the premaxillo-maxillary suture is not great; the snout expands very rapidly back to the level of the fifth maxillary teeth; there is a slight constriction at the level of the seventh maxillary teeth, followed by an expansion to the level of the ninth maxillary teeth, back of which the borders remain parallel.

THE CAVITIES OF THE SKULL

EXTERNAL NARIAL APERTURE.—The position of this opening has already been noted. In outline it is quite distinct from either *C. americanus*, *C. niloticus*, or *C. porosus*. It is broadest at its anterior end. The gently rounded anterior border is interrupted by processes of the premaxillaries which extend backward at the median line. The lateral borders are nearly straight. They converge sharply backward. The posterior border is broadly rounded.

ORBITS.—These cavities are relatively large, especially in the lateral dimension. Their external borders are nearly straight; their posterior, anterior, and internal borders form continuous curves. The general outlines of the orbits correspond rather closely with those of *C. niloticus*. The internal borders are not upturned, as in *C. porosus*. The space between the orbits is flat, and is relatively narrow; it is not deeply pitted in comparison with the rest of the skull.

SUPRATEMPORAL FENESTRÆ.—These fenestræ are rather small and are irregular in shape. Their axes of maximum length converge sharply forward. The median area of the cranial table separating the two fenestræ is narrow.

INFRATEMPORAL FENESTRÆ.—These cavities are not distinctive, and require no special description.

PREMAXILLARY FORAMEN.—The premaxillary foramen is characteristic in outline. Its form is that of an isosceles triangle in which the parallel sides are approximately twice the length of the base. A small posterior extension of the foramen is due to splitting of the specimen along the palatal median premaxillary suture before mineralization of the specimen.

PALATINE FENESTRÆ.—These cavities are irregular in shape. They resemble the corresponding fenestræ of *C. niloticus* more closely than those of any other living species of *Crocodylus*, but differ from them in details. They extend as far forward as the level of the anterior borders of the ninth maxillary teeth. Their external borders are slightly irregular, but in a broad way converge slightly backward. At a point about three-fourths of the total length backward they converge more sharply backward, as far as the junction of the ectopterygoid-pterygoid suture with the fenestral border. Posterior to this point the border again turns more nearly directly backward to the end of the fenestra.

The internal borders curve with only slight irregularities as far back as the junctions of the palatine-pterygoid sutures with the fenestral borders. From these points they extend almost directly backward to the posterior ends of the fenestræ. This portion of the skull shows the effects of crushing, consequently the two sides are not exactly alike.

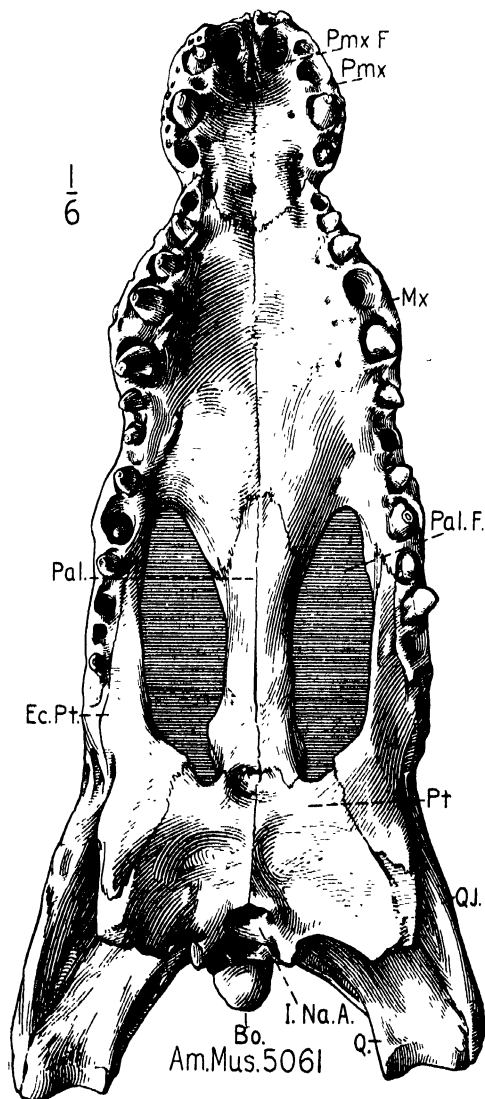


Fig. 2. *Crocodilus megarhinus* Andrews. Skull (Amer. Mus. 5061). Fluvio-marine Beds of Upper Eocene age; near Birket-el-Qurun, Fayûm, Egypt. One-sixth natural size. Inferior view.

B., basioccipital; Ec. Pt., ectopterygoid; I. Na. A., internal narial aperture; Mx., maxillary; Pal., palatine; Pal. F., palatine fenestra; Pmx., premaxillary; Pmx. F., premaxillary foramen; Pt., pterygoid; Q., quadrate; QJ, quadratojugal.

The anterior and posterior ends are abruptly rounded.

The length of the fenestra in proportion to the length of the skull from premaxillaries to condyle is greater than in any living crocodilian, but resembles various other early Tertiary forms and the Pleistocene *C. robustus* Vaillant and Grandidier, from Madagascar.

INTERNAL NARIAL APERTURE.—This cavity is not especially distinctive. It faces obliquely downward and backward, as in most living crocodiles. It is rounded triangular in outline, and its antero-posterior diameter is about seven tenths of its transverse diameter.

THE BONES OF THE SKULL

PREMAXILLARY.—The premaxillary bones are short and broad. Their anterior portions, between the nares and the anterior border, is moderately broad. It is not so broad, relatively, as in *C. americanus* or *C. niloticus*, but is much broader than in long-snouted crocodiles such as *C. cataphratus*. Perforations which lodged mandibular teeth are present in the floor of the nasal aperture anterior to the premaxillary foramen. The maximum breadth of the snout across the two premaxillaries is at the level of the posterior border of the aperture, not opposite its centre as in most crocodiles. The posterior processes of the premaxillaries which wedge between the nasals and maxillaries, are short and blunt.

On the palatal surface the premaxillaries each contain alveoli for five teeth. The first alveoli, of moderate size, are close together. On each side the first is widely separated from the second, which is small. The second is close to the third, which is large. A moderate space separates the third from the very large fourth. The small fifth is placed rather distant from the fourth, but not as distant as the first is from the second. The constriction at the side of the snout which received the fourth mandibular teeth is pronounced.

On the palate the premaxillo-maxillary suture extends forward and inward, on each side, for about twenty-two millimeters, then curves backward and inward to meet its fellow at the median line at about the level of the second maxillary teeth. The curve on each side roughly approximates a quarter circle.

The palatal length of the premaxillaries is slightly greater than their breadth.

MAXILLARIES.—These bones are relatively broad, even for a short-snouted crocodile. They occupy fully seventy-five per cent of the total breadth of the snout. The maxillo-nasal suture is unusually short.

On the palate the boundary with the premaxillaries has been described. The length along the median line is only about eighty per cent of its maximum breadth. Each maxillary occupies slightly less than one-third of the external border. The suture with the palatines extends obliquely forward and inward from the inner border of the palatine fenestra to a point on a level with the space between the eighth and ninth maxillary teeth, and about nine millimeters from the median line, thence transversely across the median line to a corresponding point on the opposite side, and obliquely backward and outward to the opposite palatine fenestra.

Each maxillary contains alveoli for thirteen teeth, many of which are preserved. The fifth teeth are, of course, the largest, but the fourth nearly equal them in size. Throughout the whole dental series the teeth are stout. Only the extreme posterior teeth are small, and they are only moderately so. All of the teeth, even at the posterior

end of the series, are lodged in distinct alveoli. The teeth are all spaced from each other, although somewhat irregularly; none of the teeth are closely appressed, as in some crocodilians.

NASALS.—The exact outlines of the nasal bones are somewhat uncertain, although enough of the sutures can be distinguished to make the main outlines reasonably certain.

The nasals do not enter the narial aperture at the surface, although it is possible that they may do so in depth. They expand regularly to the level of their maximum breadth, which is only slightly posterior to the inner ends of the premaxillo-maxillary sutures. They retain this breadth for some distance, and are only slightly narrower at their contacts with the jugals. From this point backward they narrow irregularly to the level of the eleventh maxillary teeth, where they are wedged apart by the anterior process of the frontal. At their maximum breadth they occupy about one-fourth of the total breadth of the skull.

The contacts of the nasals with the jugals and lacrymals are about equal in length, and are very short. The sutures with the prefrontals are slightly longer, and are very irregular.

LACRYMALS.—The lacrymals are long and slender. Their longest contacts are with the jugals, but the contacts with the prefrontals are nearly as long. The nasal border is short, and the orbital border is even shorter on one side.

PREFRONTALS.—These are irregularly wedge-shaped bones. Their longest contacts are those with the lacrymals. The borders with the frontal are also long, while the nasal and orbital borders are of moderate length. The prefrontals are narrow at their anterior ends, where they wedge between the nasals and lacrymals, and are broad at their posterior ends, where they form part of the orbital borders.

FRONTAL. The frontal is of moderate size only. Its posterior portion, or inter-orbital plate, is flat and not excavated or elevated as in many crocodilians. This may be partly due to crushing of the specimen. This posterior plate of the bone is considerably shorter than the narrow anterior wedge which separates the opposite prefrontals and nasals.

POSTORBITALS.—These bones are, relatively, considerably smaller than the squamosals, occupying about one-half the area of the latter. Their orbital borders are very small, but their external edges constitute fully one-third on the lateral border of the cranial table. In shape they are very irregular.

SQUAMOSALS.—The squamosal bones are relatively large. They are nearly rectangular in outline at the surface. They occupy about two-thirds of the lateral borders of the cranial table, and about half of its posterior border.

PARIETAL.—This is moderately large, slightly exceeding in its dimensions the parietal of a skull of *C. porosus* of similar size. It occupies about one-third of the posterior border of the cranial table.

On the posterior portion of the superior surface, immediately anterior to the dorsal plate of the supraoccipital, is a small depression that is crossed longitudinally by a low ridge. This is a modification of the sculptured pitting of the rough bone surface, but is quite distinct from anything seen in other crocodilians.

SUPRAOCCIPITAL.—This bone is large. It occupies about three-fourths of the distance from the posterior border of the cranial table to the foramen magnum on the posterior surface of the skull, and about one-sixth of the posterior border of the cranial table. The dorsal plate of the bone, which is part of the cranial table, is moderately

large, and is distinctly triangular in outline. The expansion of the bone on the posterior surface of the skull is considerable, the supraoccipital at this point being about three-fifths as wide as the cranial table.

JUGALS.—The jugal bones are somewhat distorted by crushing, and their characters are somewhat obscured. It is clear, however, that they were unusually slender, especially at their posterior ends.

QUADRATOJUGALS.—These bones are not especially distinctive, except that they occupy somewhat less than the usual proportion of the posterior border of the infratemporal fenestra. The sharp process, extending forward into the fenestra, which is characteristic of *Crocodylus* and *Tomistoma*, is missing on both sides of this specimen. The edge of the bone is broken at this point on both sides, however, and the process may have been present originally.

QUADRATES.—The quadrates are not especially characteristic except in the fact that they occupy somewhat more of the border of the infratemporal fenestra than is usual.

PALATINES.—The suture of the palatines with the maxillaries has already been described. The two palatines expand somewhat near their posterior ends. They are excluded from the posterior portions of the internal borders of the palatine fenestræ by narrow processes of the pterygoid, which overlap them at these points.

PTERYGOIDS.—The pterygoids occupy appreciable portions of the borders of the palatine fenestræ, external and internal, as well as posterior. The sutures with the ectopterygoids converge sharply forward.

ECTOPTYRGOIDS.—The anterior bar of each ectopterygoid extends forward to the level of the tenth maxillary teeth. The posterior bar extends quite far backward over the pterygoid.

THE MANDIBLE

The characters of the mandible are taken from another specimen (Amer. Mus. No. 5095). This jaw was not found in association with a skull, but its proportions render its reference to *C. megarhinus* practically certain.

The mandible is moderately short and broad. Its maximum breadth is between fifty and fifty-one per cent of its length. The degree of festooning of the border is relatively slight.

The symphysis is moderately long. It extends back to the level of the anterior edges of the seventh teeth. In this character it resembles the symphysis of *C. articeps* Andrews, from the same beds. The relation of the splenial bones to the symphysis is not quite clear, but apparently they did not quite meet each other at the symphysis.

The vertical diameter of the jaw is small, especially in the anterior portion. Both the external and the internal mandibular foramina are small.

The usual number of fifteen alveoli are present in the right ramus. The left ramus is incomplete; thirteen alveoli are visible in it, and probably it originally contained two more. The fourth alveoli are decidedly the largest, the tenth alveoli are second in size, and the first alveoli are third in size. The first alveoli face obliquely forward and upward. The third, fourth, and fifth alveoli are close together; the eighth and ninth are far apart; the remainder are more or less evenly spaced.

A few of the actual teeth are preserved. These are all stout and strong, with moderately sharp anterior and posterior edges. The points of the crowns tend to turn

slightly inward. The posterior teeth are as large as most of those in the anterior part of the jaw. The length of the right ramus posterior to the last alveolus is 93 per cent of the length of the alveolar series. The degree of relative shortness of the dental series does not reach the extreme condition observed in *C. porosus*. (Amer. Mus. No. 15179) in which the alveolar border is actually shorter than the postalveolar portion of the jaw.

MEASUREMENTS

Length of skull, occipital condyle to premaxillaries.....	688 mm.
Breadth across quadrato-jugals.....	340
" " anterior ends of orbits.....	286
" " fifth maxillary teeth.....	237
" " constriction.....	108
" " premaxillaries.....	152
Length, snout.....	495
Length external narial aperture.....	56
Breadth, external narial aperture.....	66
Length, right orbit.....	90
Breadth, right orbit.....	56
Length, right supratemporal fenestra.....	60
Breadth, right supratemporal fenestra.....	57
Breadth, interorbital plate.....	35
Breadth, interfenestral plate.....	17
Length of cranial table along right border.....	114
Breadth across anterior end of cranial table.....	142
Breadth across pterygoids.....	262
Median length of mandible.....	800
Length of right ramus of mandible.....	818
Breadth across condyles.....	345
Breadth, maximum.....	401
Breadth, symphysis.....	150
Length, symphysis.....	162
Length, tooth-row, right.....	425

REMARKS

In its proportions and its dental characters the skull of *Crocodylus megarhinus* resembles that of *C. niloticus*. It is not so short or massive as the living *C. palustris* or *C. porosus* of India, and it is shorter than long-snouted species such as *C. americanus*. In some characters it resembles *Osteolemus tetraspis* of Africa, but in these same characters it resembles some of the Eocene crocodylians of North America and Europe. It is slightly shorter in the snout than in *C. niloticus*, but in most characters it agrees very closely with that species. This is true to such a degree that ancestral relationship appears probable. It is very probable that *C. megarhinus* is a direct ancestor of *C. niloticus*.

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PORCUPINES FROM CHINA¹

BY GLOVER M. ALLEN

The Asiatic Expeditions under the direction of Dr. Roy Chapman Andrews have succeeded in assembling a splendid series of no less than forty porcupines from China, mammals which, on account of their size and the difficulty of capturing and preserving them, are likely to be neglected by collectors. Particular credit is due Mr. Clifford H. Pope who secured the greater part of the specimens. Two genera are represented, the brush-tailed porcupine, *Atherurus*, and the more specialized crested porcupine, currently referred to *Acanthion* although regarded by some as inseparable from *Hystrix*. Both genera are found in China in only the southern half of the country. Mr. Pope's series from the island of Hainan contains eleven old and young of *Acanthion* which prove to constitute a very distinct island form allied to that of the Chinese mainland.

Atherurus macrourus stevensi Thomas

Atherurus stevensi THOMAS, 1925, Proc. Zool. Soc. London, p. 505.

A single male skin without skull from Wanh sien, eastern Szechwan, is apparently a considerable extension northward of the recorded range of the brush-tailed porcupine in China. It agrees with *A. stevensi* Thomas, lately described from Tonkin, in the possession of numerous white woolly hairs among the bases of the spines, particularly noticeable over the shoulders. In typical *A. macrourus* from Malacca these are said to be few and brownish. For the present this Chinese form may therefore be considered the same as that from the extreme southern edge of the country, and is probably best regarded as a northern subspecies of typical *macrourus* of Malacca and the Malay Peninsula.

Atherurus macrourus hainanus J. A. Allen

Atherurus hainanus J. A. ALLEN, 1906, Bull. Amer. Mus. Nat. Hist., XXII, p. 470.

A series of seventeen skins, including a very small young one (April 13), was secured by Mr. Clifford Pope near Nodoa, Hainan, through a

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 78.

native hunter. These are very uniform in color, with the spines of the upper surfaces brown, becoming blackish on the back, intermixed with a few long white bristles over the rump. The sides are varied with whitish, each spine with a white tip and base, and brownish central ring. The lower side is soiled whitish. The small size as compared with typical *A. macrourus* is the chief characteristic difference.

***Acanthion subcristatus subcristatus* (Swinhoe)**

Hystrix subcristata SWINHOE, 1870, Proc. Zool. Soc. London, p. 638.

The common porcupine of China and its near relatives differ externally from the crested porcupine of Europe and Africa in the less development of the long erectile dorsal bristles which in the former are confined to a short space on the median part of the neck, with shorter bristles between these and the area of long spikes on the back, whereas in the latter they form a continuous crest from between the eyes to the shoulders. In the skull these eastern members differ in the much less expansion of the nasal cavity, which in typical *Hystrix* is enormously inflated, with the nasals greatly broadened and extended posteriorly so as to encroach upon the frontals. Miller in 1912 ('Mamm. Western Europe,' p. 543) restricted the name *Hystrix* to the European and African species of this type, but more recently Lönnberg (1923, Arkiv f. Zool., XV, No. 18) has advocated that all the short-tailed porcupines be referred to this genus. He recognizes, however, that they may be divided into three groups, according to the method by which the bones surrounding the nasal chamber are modified in its enlargement; but until a comparative study of all the eastern species can be made, it seems permissible to retain the genus *Acanthion* for the Asiatic species with less modified skulls. In young specimens of the Chinese *Acanthion* a striking feature of the skull is the very large size of the interparietal which is pentagonal and with an area as great as the dorsal part of a parietal in a skull 55 mm. long. In an immature *Hystrix galeata* it is a very small triangular bone.

Swinhoe mentions having often heard of the porcupine at Swatow (Kwangtung Province) and at Foochow (Fukien Province), whence he secured a specimen that later became the type of his *Hystrix subcristata*. Lönnberg records specimens from Anwhei Province, while the Asiatic Expeditions, in addition to a series from Futsing, Fukien Province, obtained one at Wanhsien, eastern Szechwan, that is similar, and another from Lichiang, Yunnan Province. The last may eventually prove to represent *yunnanensis* Anderson, but the skull is missing. Thomas has shown (Journ. Bombay Nat. Hist. Soc., XXVIII, p. 432) that this name

is valid and applies to a porcupine with short nasals, perhaps representing a species distinct from *A. subcristatus* and closely related to *A. javanicus* of Java, in which the nasals are likewise short. That this type of porcupine was formerly more widespread in China is proved by the discovery of a fossil skull with similar short nasals in Honan Province. This has been named *Hystrix (Acanthion) lagrelii* by Lönnberg (1924, Palæontologia Sinica, Ser. C, I, fasc. 3). Although the geologic age of the specimen is not known, its state of preservation suggests that it is not very ancient.

In his list of the mammals of the island of Hainan, Swinhoe (1870, Proc. Zool. Soc. London, p. 233) further records the finding of a single porcupine quill "in the jungle at Nychow (S. Hainan)," thus establishing the occurrence of *Acanthion* on that island, but it has remained for Mr. Clifford H. Pope of the Third Asiatic Expedition to secure a fine series of skins and skulls from near Nodoa, which on comparison with the series obtained by the same collector in Fukien, are found to represent a well-marked race, here described.

***Acanthion subcristatus papæ*, new subspecies**

Hystrix hodgsoni SWINHOE, 1870, Proc. Zool. Soc. London, p. 233 (not of Gray).

Hystrix subcristata SWINHOE, 1870, Proc. Zool. Soc. London, p. 638.

TYPE.—Adult male, skin and skull, No. 60048, American Museum of Natural History, from Nodoa, island of Hainan, China. January 9, 1923. Clifford H. Pope, collector; Third Asiatic Expedition.

DESCRIPTION.—Similar to *A. subcristatus subcristatus* but smaller, with a lower and slenderer skull; the nuchal crest is slightly less developed, and the large spines on the back are more extensively dark with correspondingly shorter white tips.

The general color, as in the typical form, is dark blackish brown, with a white half collar or V-shaped mark on the throat formed by short white spines, and a short crest on the mid-line of the neck consisting of elongated slender bristles most of which are deep brown at the base and white on the distal two-thirds. This crest in a series of nine adults is of much shorter and darker bristles than in the Fukien series and in a few is almost altogether wanting. The elongated slender bristles of the lower back are in both forms white except at the extreme base, but the heavier spines have the dark middle portion more extensive so that the white tips are correspondingly much shorter (35 mm. against 50 on the average for the medium-length spines) and there is an almost total lack of long heavy spines that are white throughout. The tail with spines and capsular bristles is similar in both forms but the spines are darker in the Hainan porcupine.

SKULL.—The cranium is smaller and slightly more slender throughout than in typical *A. subcristatus*, with conspicuously less vertical depth. The dorsal profile is very evenly convex and there is no trace of a postorbital process. The nasals are long, pointed anteriorly, and at first relatively narrow, expanding laterally in their terminal (posterior) third. Their combined posterior border is convex backward, its median

point reaching the level of the middle of the orbito-temporal fossa. The median and lateral boundaries of the nasals first disappear through fusion with adjacent bones. The ascending branch of the intermaxillary is narrow, tapering dorsally and with a truncate posterior border. The median length of the combined interparietal and parietals equals or very slightly exceeds that of the frontals. The cheek teeth except for their less transverse width do not differ from those of the mainland animal.

MEASUREMENTS.—The flat skin of the type which is fully adult measures about 670 mm. from snout to end of capsular bristles of the tail; the latter is about 100 mm. long.

The skull measurements follow, with those of No. 60174, adult male, from Futsing, Fukien Province, in parenthesis after each. Greatest length, 135 (138+) mm.; basal length, 121.5 (129); palatal length, 72 (79); diastema, 33 (38); median length of nasals, 74.5 (79); zygomatic width, 65 (74.5); mastoid width, 46 (52), across outer edges of palate, 28 (29.5); upper cheek teeth, 30 (29); lower cheek teeth, 29 (29); mandible from condyle to anterior point of jaw, 85 (91); depth of cranium above *m*¹, 57 (67).

The adults all agree in their small size and dark color as compared with Fukien specimens. The young ones, 165 and 190 mm. in length respectively, were both secured December 9, 1922. They are uniformly dark brown, except for a few long white quills and heavier white-tipped spines on the lower back, and a tuft of white hair at the anal region. There is no trace of white bristles on the nape nor are the bristles here elongated to form a crest.

WIND AND THE DIRECTION OF INSECT FLIGHT

BY FRANK E. LUTZ

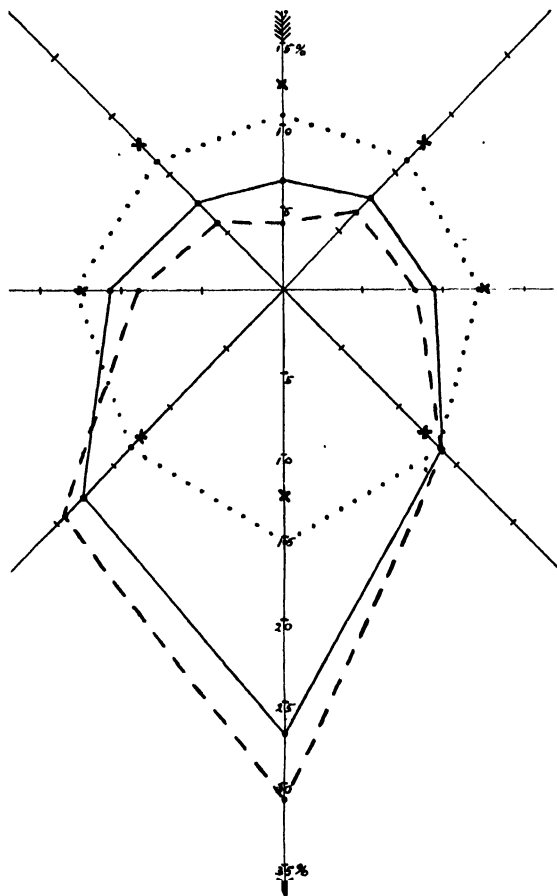
It has been rather widely accepted that insects, when flying, tend to go with the wind. The question is of importance, not only when considering the extension of the range of species but also in such problems as the attendance of insects upon flowers. The question can not, of course, be settled by watching insects whose flight is being directed by odor, since, in that case, the stimulus, odor, is itself being influenced by the air currents.

During the past summer guests at the American Museum's Station for the Study of Insects, particularly Coolidge Alden. Dr. F. W. and Mr. F. M. Brown, Frank B. Lutz and Albert Redmond, helped in the construction and care of an apparatus designed to furnish data on this point. It was an octagonal trap, really a circle of eight traps. An electric light in the middle of the apparatus furnished an equal lure in each individual trap and was uninfluenced by wind. This combination of eight traps was suspended from a horizontally placed wheel having ball-bearings. A wind-vane was so arranged that each trap was always in the same position with reference to the wind: one, up-wind; one down-wind; two cross-wind; and four quartering. The front and back of each trap being made of wire netting, wind blew directly through the apparatus.

In the six weeks between July 18 and August 29 about ten thousand insects were caught. If the wind had had no part in determining the direction of flight or, at least, the alighting from flight, there would have been approximately 12.5% of these 10,000 in each trap. However, 27.0% were in the trap that must have been entered by flying against the wind or, at least, by landing on the lee side of the apparatus, and only 6.6% were in the trap that must have been entered by flying with the wind. Taking into account the quarter-wind traps, the three-eighths of the octagon that faced in the direction toward which the wind was blowing caught 58.4%, while the opposite three-eighths caught only 21.5%. More detailed data are given by the accompanying graph.

Nearly three-fourths of these insects were Diptera and most of the remainder were Lepidoptera. Other orders were too feebly represented

to furnish independently trustworthy statistics. The accompanying table gives the weekly and total distribution among the traps of the two principal orders. See also the graph. The difference between up-wind



A circular graph showing the percentage distribution among the eight traps of the season's total of Lepidoptera (.....), Diptera (---), and of all insects (——). The radiating ordinates are marked in 5% divisions. The 12.5% points (expectation for random distribution) are marked with crosses. One pair of ordinates is drawn as an arrow flying with the wind.

and down-wind is more marked for the Diptera than for the Lepidoptera but even the latter in no week had as many individuals entering the three traps toward which the wind was blowing as would be expected

	LEPIDOPTERA								Total No.	DIPTERA								Total No.
	1	2	3	4	5	6	7	8		1	2	3	4	5	6	7	8	
Trap No.																		
July 18-25	12.1	10.6	12.5	14.3	13.9	14.1	11.6	11.0	1028	8.3	12.3	13.3	24.4	13.7	11.6	8.8	7.5	1888
July 25-Aug. 1	12.4	15.2	14.2	19.8	6.9	9.6	11.6	10.2	303	9.0	11.5	12.5	30.1	16.0	9.5	6.5	4.8	755
Aug. 1-8	9.8	12.5	19.6	14.8	14.8	8.3	8.6	11.6	337	13.8	12.9	22.5	17.2	10.2	7.8	8.7	6.8	835
Aug. 8-15	12.4	12.9	13.4	11.3	16.1	14.0	9.7	10.2	186	9.2	13.2	10.7	13.8	17.6	17.6	8.3	9.6	448
Aug. 15-22	9.8	11.3	9.8	14.4	15.5	17.0	12.9	9.3	194	7.6	8.5	10.3	26.7	22.3	10.6	6.4	7.6	816
Aug. 22-29	4.3	17.0	14.2	18.4	13.5	14.2	9.2	9.2	141	1.5	1.9	13.9	45.0	26.8	8.0	1.8	1.1	2622
Total	11.1	12.2	13.8	15.2	13.4	12.8	10.9	10.6	2189	6.5	8.2	14.0	31.1	19.4	9.9	5.7	5.0	7364

Table showing the total numbers of Lepidoptera and Diptera caught in the eight light-traps and the percentages in each trap. Traps 2 and 6 were cross-wind; trap 4 was on the lee side of the apparatus and was entered by going against the wind which blew through the netting; trap 8 received the insects which came directly with the wind; the others were quartering the wind in the order indicated.

from random distribution—to say nothing of the expectation if they tended to fly with the wind—and each week more entered the apparatus by flying against the wind than would be expected from random distribution.

So far as we could determine, there was no other factor than wind to account for these results. The traps were each of the same size (about a foot square in front) and shape; the light was equally strong in each; and, while there were trees and a building near the apparatus, the wind probably shifted enough to equalize these conditions. Of course, there is no proof that the insects were not flying about in a random fashion and merely entered the lee side of the apparatus because it was the easiest side on which to make a landing¹ but there is equally no evidence to the contrary.

Many observations indicate that insects are blown long distances by wind but, even so, it may be that they are flying against the wind at the same time and are making a negative progress in the direction of their flight. At any rate, the present evidence is that at least night-flying Diptera and Lepidoptera tend to stop their flight on the lee side of a light and it somewhat favors the notion that, in general, they tend to fly against the wind.

¹This idea was emphasized in connection with flower-visiting insects (Lutz, 1924. *Annals N. Y. Acad. Sci.*, XXIX): "Not only do most insects come up-wind to flowers, but when they come down-wind they usually pass the flower, hover a bit, then turn and come up-wind to it. . . . As to those individuals that pass a flower and then turn to make a landing, they may have been doing just that. In other words, it is doubtless easier for any flying creature or flying machine to land up-wind than down-wind." Fritz Knoll's comment (1926, *Abhand. Zool.-Botan. Gesellschaft Wien*, XII, p. 573) on the passage is: "Da diese Verallgemeinerung bestimmter Einzelfälle nach meinen Erfahrungen nicht berechtigt ist, haben die von Lutz daraus gezogenen Schlüsse keinen Wert."

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A NEW POPLAR (*POPULUS PILOSA*) FROM THE EASTERN ALTAI MOUNTAINS¹

BY ALFRED REHDER

WITH SUPPLEMENTAL NOTES ON THE DISTRIBUTION AND HABITAT

By R. W. Chaney

Populus pilosa Rehder, sp. nov.

A tree 5-12 m. high; trunk 30-75 cm. in diameter (according to R. W. Chaney); bark deeply fissured, whitish-gray; branchlets (only brachyblasts seen) thick, roughened by closely crowded scars with almost no internodes, densely pilose, glabrescent about the third year, yellowish white, the older marked with rather small blackish lenticels otherwise smooth, yellowish white; buds viscid, pubescent on the outside. Leaves ovate or broadly ovate, 4.5-8 cm. long and 4-6 cm. wide, short-acuminate, more rarely longer acuminate, subcordate at base, or truncate or rounded, slightly crenate, with minutely or indistinctly mucronulate teeth (3-5 to 1 cm.) hairy above on the slightly or scarcely raised midrib and pilose on the veins, more sparsely and finely on the veinlets and the whole surface, paler beneath, white or yellowish white, loosely pilose on the midrib toward the base, moderately densely so on the veins, otherwise glabrous or nearly glabrous; petioles subterete, 1-2.5 cm. long, densely yellowish, pilose. Fruit-bearing aments subsessile, 5-8 cm. long, dense; rachis pilose; bracts wider than long, fimbriate-laciniate and glabrous; capsules sessile, globose-ovoid, with pubescent, subcrenate disc 4-5 mm. in diameter; valves round-ovate, 4.5 long and 3.5 wide, abruptly short-acuminate at apex, pubescent on the outside.

Mongolia: Baga Bogdo, Altai Mts., stream valley and terraces, alt. 1600-2300 m., R. W. Chaney, no. 215, in 1925 (Third Asiatic Expedition Amer. Mus. Nat. Hist.).

Populus pilosa Rehder, sp. nov.

Arbor 5-12 m. alta, truncus 30-75 cm. diam. (fide R. W. Chaney), cortice profunde fissis albido-cinereo; ramuli (brachyblasti tantum adsunt) crassi, cicatricibus arcuatis congestis asperati internodiis fere nullis, dense pilosi, circiter tertio anno glabrescentes, ochroleuci, vetustiores lenticellis nigrescentibus satis parvis notati ceterum laeves, ochroleuci; perulae viscosae, extus pubescentes. Folia ovata vel late ovata, 4.5-8 cm. longa et 4-6 cm. lata, breviter acuminata, rarius longius acuminata, basi subcordata vel truncata vel rotundata, leviter crenata dentibus minute vel obsolete mucronulatis (3-5 ad 1 cm.) ciliata, supra in costa leviter vel vix elevata et in nervis

¹Publication of the Asiatic Expeditions of the American Museum of Natural History. Contribution No. 986.



Fig. 1. Photograph of an herbarium specimen showing leaf, bark, and flower of *Populus pilosa*.

pilosa, sparsius et minutius in venulis et facie, subtus pallidiora, albida vel flavido-albida, in costa basin versus satis dense in nervis laxius pilosa, in facie glabra vel fore glabra; petioli subteretes, 1-2.5 cm. longi, dense flavido-pilosi. Amenta fructifera subsessilia 5-8 cm. longa, densa; rhachis pilosa; bractee latiores quam longae, fimbriato-laciniatae, glabre, capsulae sessiles, globoso-voidae, disco pubescente subcrenato 4-5 mm. diam., valvis rotundato-ovatis, 1.5 longae et 3.5 latae, apice breviter subito acuminulatis extus pubescentibus.—Affinis videtur *Populo Przewalskii* Maxim. a qua differt praecipue ramulis gemmisque pilosis, petiolis brevioribus dense pilosis vel hirsutis, foliis utrinque ad costam venasque pilosis, et capsulis minoribus.

Mongolia: Baga Bogodo, Altai Mts., stream valley and terraces, alt. 1600-2300 m., R. W. Chaney, no. 215, in 1925 (Third As. Exped. Am. Mus. Nat. Hist.).

This new species belongs in the section *Tacamahaca* and seems most closely related to *P. Przewalskii* Maxim. (*P. suaveolens* var. *Przewalskii* Schneid.) from which it differs in the pilose branchlets and winter-buds, the densely pilose or hirsute shorter petioles and in the leaves being pilose on midrib and veins on both surfaces; the small subglobose capsules are also a prominent character. It may possibly turn out to be an extreme strongly pubescent form of *P. Przewalskii*, but as I have seen no material of that species, I prefer to consider this Mongolian Poplar a distinct species.

NOTES ON THE DISTRIBUTION AND HABITAT OF *POPULUS PILOSA* IN MONGOLIA

By R. W. Chaney

The scarcity of trees in the Gobi desert region is striking evidence of the low rainfall over this great plateau. Elms, *Ulmus pumila*, are numerous on the grasslands bordering the Gobi to the south, but have been noted in only a few cases extending northward for a short distance into the desert proper. A single willow tree, *Salix viminalis* var. *splendens*, was seen in one of the valleys at Ondai Sair. But apart from these, no trees have been noted on the Mongolia Plateau¹ outside of the canyons of the Altai Mountains, a range which extends in a southeasterly direction across the western side of the Gobi desert.

The comparative abundance of trees in the canyons of the Altai Mountains is the result of the greater precipitation there, and the higher degree of protection from evaporation by the winds which are so characteristic of the Gobi proper. Not only are trees more abundant, but plants of all sorts are more numerous and, as observed during the summer of 1925, continue in a green state long after the vegetation of the adjacent

¹The Arctic Divide to the north, with its comparatively rich forest, is considered to be geographically distinct from the Gobi.

lower country has become dry. We experienced rain on three of the six days spent on Baga Bogdo during the latter part of June, and there was a considerable fall of snow on the peak on June 20th; a month later at Artsa Bogdo there were showers on four of the five days we spent in the mountains. Several of the higher peaks, such as Baga Bogdo and Ikhe Bogdo, have snow on their tops and protected slopes during most or all of the year. This was the case in 1925, and there was ample evidence to indicate that snow had persisted for at least two years in some of the larger canyons. As a result there are permanent streams in these canyons, along which conditions for plant growth are in striking contrast to those of the arid open slopes beyond the canyon mouths. None of the streams were observed to flow beyond the mouths of their canyons before they disappeared by evaporation and by sinking into the coarse gravel and sand of the fans. It was in these canyons and in the upper portions of the fans below their mouths that *Populus pilosa* was collected and observed on Baga Bogdo and Ikhe Bogdo. None were seen on Artsa Bogdo and Gurban Saikhan, the easternmost mountains of the Altai which extend farther out into the Gobi and may be supposed to present less favorable conditions for tree growth. The occurrence in one of the larger canyons on the north side of Baga Bogdo, called Tiger Canyon by members of the Expedition, will here be described as typical of the several similar occurrences on this mountain and on Ikhe Bogdo to the west.

Tiger Canyon in its lower portion is cut into a coarse alluvial deposit, the walls rising steeply some 400 feet to an upper terrace; its width is 2000 feet at the top and a few hundred feet at the bottom. A quarter of a mile above the mouth the canyon is cut into granite and is greatly narrowed with much higher walls. A mile and a half above the mouth metamorphic rocks form a still narrower canyon. The floor is littered with coarse gravel and with boulders up to 20 feet in diameter, and there are numerous terraces which give it an irregular surface. The stream was at most only a few feet in width and less than a foot deep, as observed in June, 1925. It has a high gradient, and the water is clear and cold. Extending for several miles down the side of the mountain below the mouth of the canyon is a broad alluvial fan, cut by numerous dry channels, and littered with gravel and coarse boulders. The stream disappears into the gravel more than a quarter of a mile above the canyon mouth, but its presence in the gravels under the surface of the fan may be inferred from the distribution of trees for more than a mile down the steep slope of the fan below the mouth of the canyon. These trees, all of



Fig. 2. View of Tiger Canyon showing *Populus pilosa* growing in the steep-sided granite valley.



Fig. 3. View northward from Tiger Canyon showing the alluvial fan with scattered trees of *Populus pilosa*.

which are cottonwoods, *Populus pilosa*, are from 15 to 25 feet in height and from 8 to 18 inches in diameter. At the lower end of their distribution (elevation 5200 feet) many are dead, indicating that the supply of water there is inadequate. Except for the trees the fan is essentially bare of vegetation, but along its borders a species of *Artemisia*, as yet undetermined, is abundant together with several species of grass and legumes, and low bushes of *Prunus mongolica*.

In the canyon the trees are more numerous and larger, reaching a maximum height of about 40 feet and a diameter of up to 30 inches. Here the added protection of the canyon walls permits a more symmetrical growth of the trees. They are found along the stream for a distance of at least two miles up the canyon to an elevation of about 7500 feet where it becomes too rocky and narrow for them to gain a footing. Since most of the specific determinations of the flora have not yet been made, a complete and exact list of the associated plants cannot here be given, but it includes *Salix phylicifolia* which reaches the dimensions of a small tree, *S. glauca*, *Cotoneaster melanocarpa*, *Lonicera microphylla*, and *Spiraea chamædryfolia* among the woody plants, the fern *Cystopteris fragilis*, and numerous herbs of which the Leguminosæ and Ranunculaceæ are well represented. No seedlings of *Populus pilosa* were observed in Tiger Canyon or on its fan, but there were a few in the next large canyon to the west where there is also a permanent stream. While trees here are numerous, few of them reach the size of those in Tiger Canyon, the average diameter being little more than 8 inches. No exact count of the trees was made, but it may be conservatively estimated at several hundred in each of these two canyons. In the only large canyon observed at Ikhe Bogdo, the next large range west of Baga Bogdo, the trees were not as numerous and did not extend as far down the fan.

The use of the wood of *Populus pilosa* by the Mongols is abundantly indicated by sawed stumps in Tiger Canyon. Portions of the logs are hollowed out and made into tea mortars and water containers. The Mongol name for this tree, *Toré* meaning hollow, is indicative of this utilization of it by a people whose nearest approach to contact with forests is in the scattered groves of the Altai canyons.

In addition to *Populus pilosa* and two species of *Salix*, which were the only trees seen by the writer in the Gobi region proper, an arborescent species of *Betula* was seen by Charles P. Berkey in a large canyon on Ikhe Bogdo. It is significant to note that all three of these genera, as well as *Ulmus* of the grasslands and Gobi border of the south, have wind-borne seeds, a fact which is probably responsible in large part for their

distribution in the more suitable areas of the arid plateau of Mongolia. The source of the seeds which first established the trees of the Altai canyons may be supposed to be the higher and moister continuation of the range to the west. An alternative explanation may be that these patches of trees represent relict areas of a forest which was once more widespread and probably continuous with that farther west along the Altai Mountains. The finding by Nels C. Nelson of birch-bark utensils in a prehistoric burial north of Ikhe Bogdo is evidence, in any case, of the presence of *Betula* in the region for several hundred years.

No data are available as to the age of the trees of *Populus pilosa*, but in view of their probable slow growth it may be supposed to reach several scores of years in the case of the larger individuals. Bearing on this problem is the situation of several of the trees near the head of the fan at Tiger Canyon. The basal 8 or 10 feet of their trunks has been buried by gravel deposits, which may be interpreted as indicating a fluctuation of rainfall and therefore of deposition during the period in which they have been living.

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NEW BIRDS FROM MEXICO AND PANAMA

BY LUDLOW GRISCOM

The Department of birds has recently received a collection of some 800 specimens made by Mr. Rex R. Benson during the past summer at Almirante and Boca del Toro on the Chiriqui Lagoon, on the Caribbean slope of western Panama, just south of the Costa Rican border. This collection, in connection with the previous one made by Benson and Gaffney on the Rio Calovevora much farther east, throws important light on previously unknown factors in distribution. Until very recently, it will be recalled, no collections existed from the Caribbean slope of western Panama. We knew that there was a well-marked fauna in eastern Costa Rica and a very different one in the Canal Zone (Caribbean slope), but where these faunas met and what causes separated them were not even within the range of speculation. It now transpires that the lowlands of the Chiriqui Lagoon are an integral part of the Costa Rican fauna, as might have been expected. This accounts for the long list below of species added to Panama, and it is probably by no means complete. In combination with this fact, not a single species in this collection extends the range of a Canal Zone species westward. In only one case is the bird of Almirante more closely related to that of the Canal Zone. This is *Manacus cerritus* Peters, and it is significant that it is specifically distinct. When we examine the list of species sent in from the Rio Calovevora, the situation is exactly reversed. The great majority of the birds are identical with those of the Canal Zone, and the Costa Rican element is represented by only two species.

Besides the forms described below, the following are additions to the known avifauna of Panama: *Columba leucocephala*, *Leptotila p. plumbeiceps*, *Gallinula chloropus centralis*, *Phæthon æthereus* (a breeding colony of some thirty pairs), *Pionus senilis*, *Chætura cinereiventris phæopygos*, *Celeus loricatus diversus*, *Dechonychura typica minor*, *Pipromorpha oleaginea assimilis*, *Pitangus sulphuratus derbianus*, *Myiarchus lawrencei nigricapillus*, *Pachyrhamphus polychropterus similis*, *Carpodectes nitidus*, *Thryophilus castaneus costaricensis*, *Thryophilus zeledoni*, *Pheugopedius atrogularis*, *Dendroica b. bryanti*, *Geothlypis semiflava bairdi*, *Basileuterus fulvicauda leucopygius*, *Tanagra gouldi*, *Tachyphonus axillaris*, *Icterus*

prosthomelas, and *Psilorhinus mexicanus cyanogenys*. The Tropic Bird has never been recorded on the Atlantic coast of Central America, and a breeding colony in Panama waters is a great surprise. The discovery of the White-crowned Pigeon is even more remarkable, as in Central America it has been known only from Cozumel and Ruatan Islands. The single specimen is an immature bird, which has not quite completed the post-juvenal moult, and was undoubtedly raised on the small key where it was collected.

Eupsittula astec extima, new subspecies

SUBSPECIFIC CHARACTERS.—Nearest to *Eupsittula astec vicinialis* Bangs and Penard from Alta Mira, Tamaulipas, Mexico, but darker and duller green above and considerably darker green below, grayish greenish-olive instead of light yellowish-olive on throat and chest; radically different from typical *astec* (Souancé), Vera Cruz to eastern Costa Rica, which has a brownish buffy-olive chest, passing to olive-yellow or wax-yellow on the abdomen.

TYPE.—No. 233,593, Amer. Mus. Nat. Hist.; ♂ ad.; Almirante, Boca del Toro, western Panama; August 24, 1927; Rex R. Benson.

SPECIMENS EXAMINED

Eupsittula astec vicinialis.—MEXICO: Tamaulipas, Tampico, 1♂; San Luis Potosi, Valles, 1♂.

Eupsittula astec astec.—MEXICO: Mexico City, 1?; Vera Cruz, 1♀; Yucatan, 3♂, 3♀, 2? GUATEMALA, 3♂, 2♀. HONDURAS, 1? NICARAGUA, 1♂. COSTA RICA, 4♂, 2♀.

Eupsittula astec extima.—WESTERN PANAMA: Almirante, 2♂.

The paler and greener underparts of *vicinialis* make it appear almost specifically distinct from the brown and wax-yellow *astec*, as Messrs. Bangs and Penard justly remark. I have not cited above 1♂ and 2♀ from Rincon Antonio and Rio Givicia, Oaxaca, Mexico. Curiously enough, while quite different from typical *astec*, they are indistinguishable from *vicinialis* in color, but are very slightly smaller than any specimens in the series before me, or the minima given by Mr. Ridgway, the wing of the male 127, the two females 126–129. So minute a size difference, however, does not seem worthy of formal designation on the basis of three specimens only. The new form *extima* is even less yellow on the abdomen than *vicinialis*, but is greener and darker on the throat and chest, though totally lacking the buffy brownish olive of typical *astec*, from which it is distinguishable at a glance. Intergrades will presumably be found in south-eastern Costa Rica, where the species has not as yet been reported.

***Chalybura urochrysa incognita*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Chalybura urochrysa isauræ* (Gould) of "Bocca del Toro, Costa Rica" (now western Panama), but adult male with throat and breast greener, much less blue; under tail-coverts pure white, and tail more golden bronzy; rump and upper tail-coverts coppery bronze without purple or violet; female, easily separable on the same rump and tail characters.

TYPE.—No. 135,442, Amer. Mus. Nat. Hist.; ♂ ad.; Tacarcuna, eastern Panama; March 30, 1915; W. B. Richardson.

SPECIMENS EXAMINED

Chalybura urochrysa isauræ.—Western PANAMA: Boca del Toro and Almirante, 3 ♂.

Chalybura urochrysa incognita.—Eastern PANAMA: Tacarcuna, 10 ♂, 5 ♀.

Chalybura u. urochrysa.—Western COLOMBIA, 6 ♂, 1 ♀.

The receipt of three adult males of *Chalybura isauræ* from the type locality confirms Dr. Chapman's remarks in his 'Birds of Colombia,' p. 294, and shows that the series recorded by him from eastern Panama represents an undescribed form. Gould's description of *isauræ* was based on a "somewhat immature" specimen, which perhaps accounts for his guess that the adult would have a "fine green breast," whereas it is deep bluish-green. In my three specimens, the under tail-coverts are never pure white, either smoky gray or at least edged with that color, quite different from the pure white of *incognita* and *urochrysa*.

We now come to a totally different question, involving nomenclature. While the eastern Panama bird differs very radically from the Boca del Toro specimens, an old male from the Gould Collection labelled "Santa Fé, Veragua," Arcé (of course Caribbean, not Pacific slope) is intermediate, as is also a female from the Rio Calovevora. Turning now to *C. urochrysa*, we find that the same differences separating *incognita* from *isauræ* are merely carried a step farther. All trace of blue in the throat is lost, and tail and rump are golden bronze. It seems to me, therefore, that we can regard these three Hummingbirds either as distinct species or as representative subspecies, in which case the specific name would be *urochrysa*, which has page priority. It would be entirely illogical to regard *incognita* as a race of *isauræ*, and maintain *urochrysa* as specifically distinct.

***Chloronerpes simplex auroræ*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to, typical *Chloronerpes simplex* Salvin of Costa Rica and extreme western Chiriqui (Pacific slope), but more golden brown above, particularly noticeable on the pileum of females; underparts less greenish olive, more golden brown, the spotting on throat and chest greatly reduced.

TYPE.—No. 233,594, Amer. Mus. Nat. Hist.; ♀ ad.; Almirante, Boca del Toro, western Panama; May 20, 1927; Rex R. Benson.

SPECIMENS EXAMINED

Chloronerpes simplex simplex.—COSTA RICA, 1 ♂, 1 ♀. NICARAGUA, 2 ♂, 1 ♀.

Chloronerpes simplex aurora.—Caribbean slope of western PANAMA: Boca del Toro, 3 ♂, 1 ♀; Rio Calovevora, Veraguas, 1 ♂.

It was a great surprise to find this species in a region from which *Chloronerpes callopterus* has been reported, as Arcé's specimen from "Veragua" must almost certainly have come from the Caribbean slope. The new form of *simplex* is slightly, but distinctly, characterized by its more golden brown, less greenish olive color.

***Hylopezus fulviventris flammulatus*, new subspecies**

SUBSPECIFIC CHARACTERS.—Nearest *Hylopezus fulviventris dives* (Salvin) of eastern Nicaragua and Costa Rica, but very slightly darker both above and below; wing quills browner, less olive and slaty, the exposed margins chestnut, rather than cinnamonaceous; chest much more heavily flammulated with black.

TYPE.—No. 233,595, Amer. Mus. Nat. Hist.; ♂ ad.; Almirante, Boca del Toro, western Panama; May 16, 1927; Rex R. Benson.

SPECIMENS EXAMINED

Hylopezus fulviventris dives.—Eastern NICARAGUA, 6 ♂, 2 ♀.

Hylopezus fulviventris flammulatus.—Western PANAMA, 2 ♂.

Hylopezus fulviventris barbacoæ.—Eastern PANAMA: Tacarcuna, 1 ♀. Western COLOMBIA, 4 ♂, 1 ♀.

The specimens here described serve to bridge most of the gap in range formerly existing between the Colombian and Central American representatives of this little Ant-Pitta. The more richly colored wings and the heavily flammulated chest are readily noticeable characters.

Through the generosity of Dr. L. C. Sanford, The American Museum of Natural History has recently acquired a small collection of birds made by W. W. Brown in recent years in various parts of San Luis Potosi, Tamaulipas, and Vera Cruz, which contains the following undescribed forms. I am greatly indebted to the authorities of the Biological Survey and the Museum of Comparative Zoölogy for the loan of indispensable comparative material.

***Nannorchilus leucogaster griseus*, new subspecies**

SUBSPECIFIC CHARACTERS.—Nearest to typical *Nannorchilus leucogaster* (Gould) of southern Tamaulipas, but upperparts decidedly grayer brown, with no buffy or isabella tinge; underparts and superciliary stripe much grayer, the throat and abdomen nowhere nearly pure white, the flanks a grayer brown, less buffy or isabella.

TYPE.—No. 230,342, Amer. Mus. Nat. Hist.; ♀ ad.; Ebano, San Luis Potosi, Mexico; April 19, 1922; W. W. Brown.

SPECIMENS EXAMINED

Nannorchilus l. leucogaster.—Southern Tamaulipas, 3 ♂, 6 ♀.

Nannorchilus l. grisescens.—San Luis Potosi, Ebano, 2 ♀.

Nannorchilus l. musicus.¹—Extreme southern Vera Cruz, 3 ♂.

Nannorchilus l. pacificus.¹—Colima, Manzanillo, 1 ♂, 1 ♀.

Of the four described subspecies of this little Wren, the Yucatan race *brachyurus* is easily differentiated from the others by its distinctly barred tail. The typical form is intermediate between the other two, *pacificus* being the palest and most rufescent, *musicus* the darkest and most richly colored. All three are brown birds above, rufescent in *pacificus*, isabella or broccoli brown in *leucogaster*, deep russet or wood brown in *musicus*. The flanks vary through very similar color shades. In all three the throat and abdomen are nearly pure white. It will therefore be apparent that the form here proposed is apparently quite distinct from the others in its pronounced gray shading both above and below.

***Carpodacus mexicanus potosinus*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Carpodacus mexicanus rhodocolpus* Cabanis, but adult male in breeding plumage a darker bird throughout, the red areas more crimson or carmine, less scarlet; brown of upperparts darker, and brown streaking below heavier, darker and more distinct; adult male in winter plumage with the red areas a rose purple shade as in *rhodocolpus*, but more heavily and darkly streaked below, and upperparts with pronounced gray edgings, giving almost a hoary effect, particularly noticeable on the hind-neck and auricular region; females darker above and more heavily streaked below.

TYPE.—No. 25,953, Museum of Comparative Zoölogy; ♂ ad.; San Luis Potosi, Mexico: March 24, 1879; Dr. Ed. Palmer.

***Carpodacus mexicanus nigrescens*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Carpodacus mexicanus potosinus* nobis above, but adult male even darker throughout, the red areas slightly so, but upperparts, primaries and streaks below dark fuscous or blackish brown; adult female and young of both sexes also darker in the same respects.

TYPE.—No. 230,408, Amer. Mus. Nat. Hist.; ♂ ad.; Miquihuana, Tamaulipas, Mexico; July 11, 1922; W. W. Brown.

SPECIMENS EXAMINED

Carpodacus mex. rhodocolpus.—7 ♂, 5 ♀ from Durango, Jalisco and Zacatecas.

Carpodacus mex. potosinus.—San Luis Potosi, 21 ♂, 15 ♀.

Carpodacus mex. nigrescens.—Tamaulipas, Miquihuana, 2 ♂, 2 ♀.

Many years ago Mr. Ridgway referred a juvenile female from Miquihuana to typical *mexicanus* with a question mark. Breeding males now available from the same place show the greater extension of the red areas,

¹Courtesy of Museum of Comparative Zoölogy, Cambridge, Mass.

characteristic of *rhodocolpus* and its allies, but are darker than any other race of the species, and are distinguishable at a glance. Even the juvenal female in the Biological Survey collection shows this general darkness of coloration, which probably explains Mr. Ridgway's question mark.

The subspecies *potosinus* is geographically intermediate between *rhodocolpus*, *frontalis* and *nigrescens*. In darkness of coloration it is intermediate between *rhodocolpus* and *nigrescens*. It differs from *frontalis* in all the respects in which it differs from *rhodocolpus*, and in addition in all the characters separating those two races. In so variable a species it is highly desirable that the type of a new form should be based on a breeding bird. The type of *potosinus* is consequently fixed on a breeding specimen, one of many loaned by the Museum of Comparative Zoölogy. The specimens in the American Museum are all winter birds.

In addition to the forms diagnosd as new above, this collection contains numerous rare or little-known species and subspecies of Mexican birds, new to this Museum. Perhaps the most notable bird in this group is *Chlorospingus sumichrasti* Ridgway (2 ♀ from Potrero, Vera Cruz). So far as I know only the type specimen is on record.

Notable extensions of range are as follows.

Colibri thalassinus (Swainson).—A series from Alvarez, San Luis Potosi.

Catharus occidentalis olivascens (Nelson).—This species seems to be rare in collections, and this very distinct subspecies is known only from Chihuahua. Much to my surprise a breeding male from Miquihuana, Tamaulipas, is quite indistinguishable from a series of *olivascens*, kindly loaned by the Biological Survey.

Ptilogonys c. cinereus Swainson.—Three from Alvarez, San Luis Potosi.

Geothlypis trichas melanops Baird.—Mr. Ridgway's guess that the breeding range of this imperfectly known form is toward the northern and western confines of the Mexican Plateau is apparently correct. A series of five males and two females taken in late May at Pacheco, Chihuahua, are typical of this strongly marked subspecies.

Atlapetes pileatus dilutus Ridgway.—This form is known only from Chihuahua. A small series from Alvarez, San Luis Potosi is inseparable.

59.7, 58 E

THE SMALLEST KNOWN SPECIMENS OF THE SUCKING-FISHES, *REMORA BRACHYPTERA* AND *RHOMBOCHIRUS OSTEOCHIR*

BY E. W. GUDGER

In a previous paper,¹ based on an exceptional collection of young Echeneididae, I brought together all the data, both new and previously published, descriptive of the smallest known specimens of these most interesting fishes. This paper was illustrated with figures (three of them never before published) of four of the eight species enumerated in Jordan and Evermann's 'Fishes of North and Middle America.' While this paper was in press, I received from the Danish investigator, A. Vedel Tåning, a paper² in which he described post-larval stages of *Remora remora* as small as 5.6 mm., and of *Echeneis lineata* as short as 14 mm.—specimens much smaller than mine.

My smallest *Rhombochirus osteochir* was 68 mm. over all and 61 mm. from tip of snout to base of caudal fin. Two other specimens measured in total length 73 and 105 mm. respectively. The smallest fish was taken from the gills of a sailfish (*Tetrapturus* sp.?) at Long Key, Florida, and was presented to the Museum by Mr. Hamilton M. Wright of this city. Mr. Wright, knowing my great interest in and desire for small shark-suckers, later enlisted the kind co-operation of Mr. H. W. Mittag, Secretary of the Miami Anglers' Club of Miami, Florida, and he in turn secured the help of the boatmen having boats for charter to anglers. The results of this were that Captain A. Hutter of the yacht 'Tramp' secured from sailfish (*Tetrapturus* sp.) taken in the Gulf Stream just outside Miami between June 15 and July 20, 1927, eight specimens of sucking-fishes. Examination of this material showed that there were one *Remora brachyptera* and seven specimens of *Rhombochirus osteochir*, of which three are smaller than any previously recorded.³

¹Gudger, E. W. 'A Study of the Smallest Shark-suckers (Echeneididae) on Record, with Special Reference to Metamorphosis.' American Museum Novitates, 1926, No. 234, 26 pp., 6 figs.

²Tåning, A. Vedel. 'Position du Disque Céphalique chez les Echeneides au Cours de l'Ontogenèse' Comptes Rendus Académie Sciences, Paris, 1926, 182, pp. 1293-1295, 2 figs.

³To Mr. Wright, Secretary Mittag, and Captain Hutter I make my best thanks. It is kindness such as theirs that makes possible the collection and study of such rare and unusual specimens of fishes as these on which this article is based.

Remora brachyptera

This fish is the smallest on record. Its total "over all" length is 88 mm., to base of caudal fin 77 mm. Depth behind disk 12 mm. Width between upper edges of bases of pectorals 11 mm. Length of base of dorsal fin 27 mm., of base of anal 25 mm.

It has 15 segments in its sucking disk, which is 24 mm. long by 13 wide. The soft dorsal has 26 or 27 rays, and the anal 24 or 25—the count is very difficult. The pectoral has about 20 rays, the pelvic 5, and the caudal has 19 rays. The caudal is very blunt, without a notch, almost squarely truncate. The color (formol specimen) is a light ashen, and of about the same shade above, laterally, and below. The lower jaw is very bluntly rounded and projects beyond the upper by 2 mm. Dis-



Fig. 1.—*Remora brachyptera*, the smallest known specimen, 77 mm. in standard length.

tance between eye and angle of mouth $\frac{1}{2}$ the distance from angle to tip of upper jaw.

The smallest fish of this species, recorded in my earlier paper, are two described by Lütken in 1875 from the rich collections in the Copenhagen Museum. These were about 4 inches (101 mm. long) and interesting to state were like mine taken from the gills of a round-billed sailfish (*Tetrapturus*). This fish, however, came from the south Atlantic—about 300 miles east of Cape San Roque, Brazil.

My specimen—the smallest known (77 mm., 3 in., in standard length)—shows absolutely no trace whatever of larval characters, is adult in every respect save in size. In other words, it gives no indication of any post-larval metamorphosis whatever, as may be seen by reference to Figure 1. Unfortunately no data is at hand for the maximum or for even the average adult size.

Rhombochirus osteochir

The smallest specimen of this fish recorded in my previous paper was 68 mm. "over all" and 61 mm. to the base of the caudal, while the next smallest gave measurements of 73 and 62 mm. for these respective lengths. This smaller fish, which had 17 lamellæ in its disk, and which was figured in my previous paper, was also the gift of Mr. Hamilton M. Wright as noted in the introduction to this article. However, the three specimens before me are much smaller than it, are probably the smallest ever studied by any investigator. Their dimensions are recorded in the accompanying table—all measurements being in millimeters.

Rhombochirus osteochir, juvenile forms from Miami, Florida

	No. 1	No. 2	No. 3
Length, tip of snout to tip of caudal	36	46	55
Length, tip of snout to base of caudal	32	41	49
Length of disk	11	15	19
Width of disk (greatest)	5	7	8
Number of lamellæ	16	17	18
Length of head	9	11	13
Length of base of soft dorsal fin	12	14	18
Length of base of anal fin	11	14	17.5

If the figures for any one character noted in the table be compared, a regular gradation will be perceived. We even have a gradation in the number of segments in the sucking disk, and just here it may be noted that at the hinder end of the disk of fish number 2 there is what appears to be the rudiment of another lamella.

Fishes Nos. 1 and 2 are so small and their dorsal and anal fins are so fleshy and dark colored that I have not been able to count the rays. Fish No. 3 has about 22 rays in the soft dorsal, about 21 in the anal, 19 or 20 in the pectoral, 5 in the pelvic, and 16 in the caudal. The pectoral is thick, broad and rounded with the first two rays very broad, stiff, and strong. The caudal is deeply emarginate with the points bluntly rounded, whereas in the two small fish previously reported on the tips were pointed.

However, in a third small (105 mm.) specimen studied along with these two, the points were rounded. Evidently there is considerable variation here. These structures are clearly shown in Figure 2 wherein are portrayed all three of the fish listed above.

In color all three of my present specimens are ashen with a blue-gray sheen, about equal in shade above and below. Their dorsal and anal

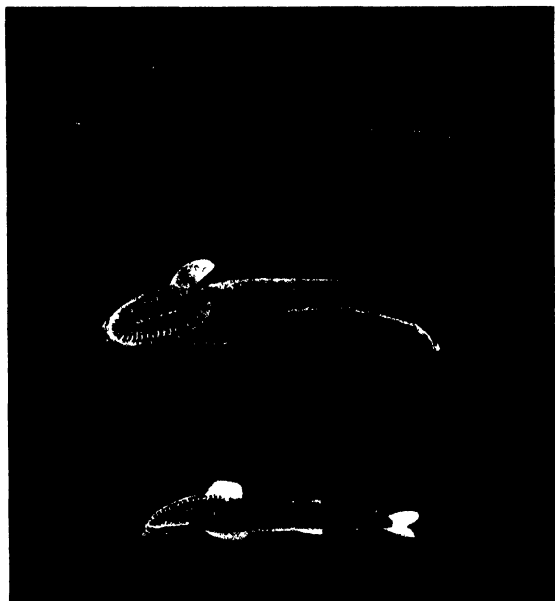


Fig. 2.—The three smallest known specimens of *Rhombichirus osteochir*. These are 55, 46, and 36 mm. standard length respectively, and are shown in natural size.

fins are a blue-black. Their pectorals are transparent as are the pelvics of the smallest, but these fins in Nos. 2 and 3 are very dark—about the color of their respective anals. The caudal fin of No. 1 is transparent, of No. 2 quite black, while that of No. 3 is intensely so.

There can be no doubt that these three little “suckers” are correctly identified as *Rhombichirus osteochir*. They and the three specimens previously studied form a well-graded series of small forms extending in length from 36 mm. to 105 mm. These, together with the six or eight

larger specimens from Florida and California, give the American Museum a rather complete series of this interesting sucking-fish.

Finally, emphasis should be laid on the fact that in this genus of the remorine division of the Echeleidæ in specimens down as small as 36 mm. in total length there is not the faintest trace of any metamorphosis in any organ, not even in the caudal fin. And in this these specimens agree absolutely with the small forms previously studied of the other genera and species of the Remora group. On the contrary, it was clearly shown in my previous paper that in both genera of the Echeis group the post-larval young have the central fin rays greatly prolonged to form a tri-lobed caudal fin, in which the central lobe becomes progressively reduced with growth and age. Here then we have added evidence that this matter of the caudal fin is of positive value in separating the Echeleidæ into two well-marked divisions or groups.

59.7.5 . . . P (59.3)

THE SYSTEMATIC POSITION OF THE PHALLOSTETHID
FISHES, WITH DIAGNOSIS OF A NEW GENUS FROM
SIAMBY GEORGE S. MYERS¹

In 1913, C. T. Regan announced the discovery, in Johore on the Malay Peninsula, of one of the most remarkable fishes known up until that time. This minute species, *Phallostethus dunckeri*, he placed with the cyprinodonts, although it differed remarkably from all the members of that group, and, indeed, presented structures until then entirely unknown among fishes. Pelvic fins were reported as vestigial in the female and absent in the male, whilst below the head and throat of the latter was a most peculiar appendage containing the coiled vas deferens and the end of the intestine, together with a complicated skeletal system mostly of what appeared to be entirely new elements. This appendage, called by Regan the priapium, bore externally two long curved bones apparently used as clasping organs. These are the toxactinium and ctenactinium of his descriptions.

In 1916 Regan published a detailed account of the anatomy of this peculiar group of fishes, based primarily on studies of a new genus and species, *Neostethus lankesteri*, from the Muar River and Singapore, describing also another new form, *N. bicornis*, from Kuala Langat, and reviewing the morphology of *Phallostethus*. All three forms were from brackish water and this habitat and their appearance seemed to force the conclusion that they were killifishes, a family common in such situations throughout the tropics. Regan states that they "obviously belong to the large and varied family Cyprinodontidæ," in which he erected for them the subfamily Phallostethinæ.

Nothing more was heard of these fishes for a number of years, Weber and de Beaufort (1922, p. 381) merely raising Regan's subfamily to family rank. Jordan (1923) also accorded the group family standing, along with several other groups of cyprinodonts.

In 1925 a new genus of phallostethids, *Gulanhallus*, was described by A. W. T. C. Herre, from hill-streams in Luzon, Philippines. The habitat of the two species, *G. eximius* and *G. mirabilis*, is thus quite

¹Of Stanford University, California.

different from the brackish one of the two previously known genera. More remarkable, however, was Herre's report that both of his species possessed a spinous dorsal fin. This should have immediately suggested a new view of the family relationships, but Dr. Herre did not attempt a re-allocation. In fact, in a later paper (Herre, 1926), he has stated the group to be cyprinodonts.

Very recently Herre (1926) has announced another new genus and species, *Mirophallus bikolanus*, from Lake Bato and Lake Lanigay, South-eastern Luzon. This he describes as having no trace of a spinous dorsal.

Not long ago, in correspondence concerning some cyprinodonts, Dr. Hugh M. Smith of the Siamese Fisheries Department mentioned to me that he had found *Neostethus lankesteri* in streams about Bangkok. At my request he kindly sent me some specimens, telling me that the fish possessed a spinous dorsal, and that upon his request, Mr. J. R. Norman had examined Regan's types in the British Museum and found them likewise to possess this structure. Mr. Norman's letter, kindly forwarded by Dr. Smith, reads in part:

"I have carefully examined the types of *Neostethus lankesteri* and *N. bicornis*, and find that the structure mentioned in your letter is present in both species. This has the form of a single, rather short, flexible ray, situated a short distance in front of the dorsal fin. It appears to have been overlooked by Mr. Regan in his description."

Thus it will be seen that the first dorsal is present in *Neostethus*, but with one ray instead of the two of *Gulaphallus*. That it was overlooked by Regan in his detailed morphological study is surprising, but the ray is extremely inconspicuous in material that I have examined, sent by Dr. Smith. Whether or not *Phallostethus* has such a structure is not stated.

Recently Dr. Smith has published some interesting observations (Smith, 1927) on the species that he has observed at Bangkok. Most interesting of his statements is that the fish is oviparous, although he says he has not observed the spawning habits. This is the more remarkable since it has been supposed, on account of the peculiar priapial structures of the male, that the phallostethids are viviparous. Dr. Smith further states that they live in very turbid water, feeding on plankton. They swim in small schools, and, due to the translucency of the body, would not easily be seen "were it not for a triangular glistening yellow area on top of the head with its apex on the nape." Dr. Smith has suggested that the spinous dorsal precludes placing the group with the cyprinodonts, but no allocation is attempted.

Dr. Smith has identified his fish with *Neostethus lankesteri* Regan, and in his paper he has mentioned the ctenactinium, a bone characteristic of that genus. It is thus remarkable that the specimens he sent to me, presumably the species mentioned in his article, either have no ctenactinium or have that bone so modified as to be extremely unlike that of *Neostethus*. They have a priapium more like that of *Phallostethus*, with a curved *toxactinium* at the anterior end, and they represent, in fact, a new generic type connecting *Phallostethus* with *Neostethus* and *Gulaphallus*.

In view of the evident systematic misplacement of the family, of the discovery of a new genus, and of the fact that Dr. Herre seems to have made certain errors in the interpretation of the priapial elements of his material, it seems desirable to review briefly the genera and species of Phallostethidæ and give some notes on the probable position of the group.

No member of the order Cyprinodontes (Microcyprini) is known to have a spinous dorsal fin, the older classifications placing the group, as a single family (or two), in the Haplomi, next to the Esocidæ, far from the highly developed spiny rayed Acanthopterygii. Regan, in 1909 (p. 78), first showed that the cyprinodonts could not be placed with the Haplomi, and he erected a new order, Microcyprini (=Cyprinodontes), for them. Later (1911) he enlarged upon this view and presented a classification of the order. Again, Hubbs (1924, p. 3) has pointed out that in premaxillary form, position of the pectoral and pelvic fins, pelvic rays, number of vertebræ, and the character of the branchiostegals, the cyprinodonts approach much nearer to the acanthopterygian type than has generally been supposed.

Were it not for the spinous dorsal fin, the position of the Phallostethidæ among the cyprinodonts would scarcely be questioned. Yet that character assuredly prevents us placing them there, and casting about for possible relations, we are struck with the resemblance of the phallostethids to atherinoids. In fact, none of the characters of these fishes at present known, and not connected with the peculiarly modified priapial region, would offer any serious obstacle to placing the family in the order Percosoces close to the Atherinidæ.

In making this transfer, one comes to ask himself if there is really so great a difference between the cyprinodonts and the percosocians as has been assumed in the systems of classification now in vogue. The character of the cyprinodont ethmoid region, widely divergent from that of *Esox*, does not greatly depart from the atherinoid type. Further, the cyprinodonts seem to be uniformly physoclistous and the peculiarly

typical mouth of this group is closely approached by the Atherinidæ. The strongest point of difference is the small first (spinous) dorsal of the atherines, and in at least one form this may occasionally be absent. The idea that the two groups may not be very distantly related has been suggested to me recently by Mr. Carl L. Hubbs (*in litt.*). The possibility had occurred to me sometime previously, in fact before I had studied the phallostethids, but Mr. Hubbs's suggestion has somewhat strengthened my own notion. This view is not a new one, however, for as long ago as 1870, Cope (p. 455) suggested that the atherinids and cyprinodonts might be very close. Later, when describing *Protistius semotilus*, Cope (1874) remarked on the similarity of the fish to both the Mugilidæ, percesocian relatives of the Atherinidæ, and the cyprinodonts, and in later papers he referred to this really atherinoid genus as a cyprinodont. Cope's views on the matter have generally been overlooked or ignored by recent workers.

However close the Cyprinodontes may be to the Percesoces, I do not believe that the phallostethids are more closely related to the cyprinodonts than are any of the known Atherinidæ. They probably represent a specialized offshoot of the atherinoid stem. Neither do I believe that the occasional absence of a spinous dorsal in *Baslichthys* (*Protistius*) or its apparent constant absence in the phallostethid *Mirophollus* shows direct relationship to the cyprinodonts. Likewise the cyprinodont *Lamprichthys* of Lake Tanganyika, which has assumed the form and habits of an atherinid, cannot be held as showing relationship to that group. *Lamprichthys* appears to have independently evolved its characters from a high-pectoraled cyprinodont group such as the tribe Aplocheilichthyini now is.

It is unfortunate that we have as yet no detailed account of the phallostethid skull, Regan's paper dismissing most of the skeleton with the statement that it is "typically cyprinodont." Study of the skeleton of these excessively minute fishes is extremely difficult and I have not had sufficient material or proper equipment for an examination detailed enough to be of value.

PHALLOSTETHIDÆ

Percesocians at times lacking the external manifestation of a spinous dorsal fin, differing from the Atherinidæ in the reduction or absence of the pelvic fins and the presence, in the male, of a highly developed copulatory or clasp ing organ (the priapium) beneath the head, supported by a system of bones not (at present) capable of homologization with any

bones of the other families of the order. Physoclistous. Premaxillaries protractile. Teeth conical, in rows. Pectoral fins high. Caudal emarginate or forked. Hamal arches of caudal vertebræ not expanded.

The priapium has been very fully described and its structure investigated in the genera *Phallostethus* and *Neostethus* by Regan (1916). Internally it has a complex skeleton, the principal external manifestations of which are some long curved bones apparently used as claspers. One or two may project from one (the aproctal) side at the posterior end of the priapium; these are the ctenactinia. Another, the toxactinium, may project from the anterior end. The end of the intestine runs forward and down from the abdomen into the priapium, and opens at the proctal side of that organ. The vas-deferens similarly runs down into the priapium, where it enlarges and coils, its opening being somewhere at or near the posterior end of that structure.¹

The proctal side may be indifferently either the right or left of the fish; in other words, the males are either "rights" or "lefts." So far as observed all the females are symmetrical.

In the females there may be a groove in which the anus, oviduct, and ureter terminate, or the groove may be absent, the openings merely being in line on the abdomen. A pair of papillæ, possibly representing the pelvic fins, may or may not be present in differing positions on the abdomen.

In both sexes, beginning behind the priapial attachment or the ureter opening, there is a rayless fringe extending along the midline of the abdomen, terminating just before the anal fin origin. The fringe is not figured or described in Herre's account of *Mirophallus*.

SYNOPSIS OF THE GENERA

- A. Toxactinium present, a shield-like pulvinulus covering its base.
 - B. Anal fin very long, of 26 to 28 rays; jaws equal or the lower slightly included; spinous dorsal (?); abdomen of female with a groove.

Phallostethus Regan.
 - BB. Anal fin moderate, 14 or 15; lower jaw strongly prognathous; spinous dorsal of one spine; abdomen of female without groove.

Phenacostethus Myers.
- AA. Toxactinium absent, pulvinulus if present small and not shield- or disc-shaped.
 - C. Spinous dorsal present.
 - D. One spine in spinous dorsal fin; nape and opercles naked (?); one or two ctenactinia. *Neostethus* Regan.
 - DD. Two spines in spinous dorsal; nape and opercles naked; two ctenactinia. *Gulaphallus* Herre.
 - CC. Spinous dorsal absent; nape and opercles scaly.

Mirophallus Herre.

¹Herre, 1926, p. 538, has erroneously stated that the INTESTINE coils within the priapium.

Phallostethus Regan

REGAN, 1913, p. 548.

GENOTYPE.—*P. dunckeri* Regan.

This genus, the first known of the family, differs from all the others in the very long anal. A single, short, comb-shaped ctenactinium is present at the posterior part of the priapium. A long, curved toxactinium projects forward from the anterior end of the priapium, and at its base is a flat, oval, plate-like structure, the pulvinulus. The bones of the pectoral arch are expanded and largely free below and protect the base of the priapium. In the female the anus, oviduct, and ureter, as well as the abdominal fringe, lie in a groove. Jaws equal or the lower slightly included when mouth is closed. It is not known whether or not a spinous dorsal is present in this genus.

Phallostethus dunckeri Regan

REGAN, 1913, p. 549, Figs. 1-4; 1916, pp. 16-19, Figs. 12-15, Pl. I, fig. A.

Anal 26 to 28. Dorsal 8 to 10. Scales 40. Length (total) 29 mm. The known specimens come from Johore, Malay Peninsula, and are in the British Museum and the Hamburg Museum.

This fish bears a remarkable resemblance to the South American poeciliid cyprinodont *Tomeurus gracilis* Eigenmann, probably having similar habits and habitat. Named for Dr. Georg Duncker, who first mentioned these fishes (Duncker, 1904), though without giving them a name.

Phenacostethus, new genus

GENOTYPE.—*P. smithi* Myers.

Anal fin moderate in length. A spinous dorsal fin of one short, rather soft spine situated above the posterior half of the anal fin. Priapium low and elongate, lacking a ctenactinium unless the irregular structure beside the opening of the vas-deferens be this bone. A hooked toxactinium projecting forward from the anterior part of the priapium, its base emerging from a large, flat, oval pulvinulus. Pectoral girdle expanded, skin-covered, and largely free from the body below. In the female, the abdominal fringe, anus, the oviduct and ureter-opening not in a groove. Head, nape, and opercles unscalled.

Allied to *Phallostethus* in the presence of a shield-like pulvinulus and a toxactinium, and to *Neostethus* and *Gulaphallus* in the short anal and character of the female abdomen.

Phenacostethus smithi, new species

HOLOTYPE.—No. 9247 A. M. N. H., left adult male, 13.5 mm. standard length (16.5 mm. total). Bangkok, Siam, freshwater stream. H. M. Smith, collector. December, 1926.

SPECIFIC CHARACTERS.—Body well compressed. First dorsal I. Second dorsal 6½. Anal 14 or 15. Scales about 30 to 33, mostly lost on the types, the number and position apparently agreeing with the very conspicuous myotomes; scales transparent

and inconspicuous. Dorsal fins placed far back, the first above the posterior half of the anal, the second originating above the end of the anal base. Depth 5 to $5\frac{1}{2}$. Head about $4\frac{1}{2}$. Eye large, about 2.66 in head, without lower jaw. Mouth fairly large, extending to beneath the anterior part of the eye. Lower jaw projecting. I have not been able to determine whether or not there is more than one row of teeth.

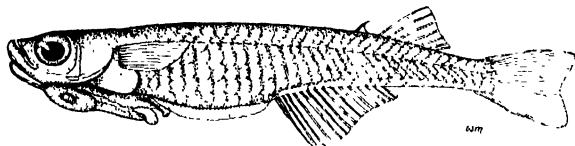


Fig. 1. *Phenacostethus smithi*, new species. Left ♂ adult, aprocctal side. 13.5 mm. standard length.

Snout a little over half eye. Pulvinulus much larger than eye, its face inclined to the side toward which the hook of the toxactinium turns, this being termed the aprocctal side. This may be either right or left. Priapium much elongate, projecting downward but little. Vas-deferens coiled within and opening at the tip of a curved ending (Fig. 2, no. 5). Next to this is a peculiar, irregular, curved, hard projection (Fig. 2, No. 7) which may be the homologue of the ctenactinium. The largely free, skin-covered pectoral girdle extends downward on each side of the base of the priapium.

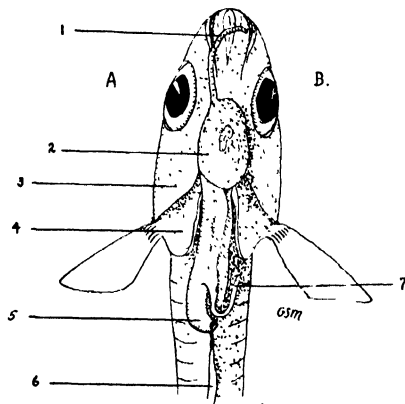


Fig. 2. Underside of head of *Phenacostethus smithi*, left ♂ adult. 1. Toxactinium. 2. Pulvinulus. 3. Opercle. 4. Pectoral process. 5. Vas-deferens. 6. Abdominal fringe. 7. Ctenactinium? A. Proctal side. B. Aprocctal side.

On the aprocctal side it covers what appears to be the "glandular groove," while a shallower groove is on the proctal side. The specimens being small and not very well preserved, some of the minute characters, such as the position of the anus and ureter opening of the male, cannot be made out, even under high magnification of the binocular.

The female is in general similar to the male, excepting of course, in the priapial region. There is no groove on the abdomen of the female. What appear to be the

homologues of the post-anal papillæ are present, if my observations are correct, **BEHIND THE OPENING OF THE URETER**, and they appear very like small pelvic fins. Their position is rather different from that of the papillæ of Regan's three forms

Colorless; dorsum with a slight dark shade; occiput darker. Myotomes very evident.

Nineteen paratypes, 11 males and 8 females, are deposited in The American Museum of Natural History, the United States National Museum, and my own collection.

This little fish is, next to *Mistichthys luzonensis*, a Philippine goby described by Dr. Smith, the smallest of vertebrate animals, the largest adult in the type series being but 14 mm. standard length and only 17 mm. total.¹ One 11.5 mm. (standard) male paratype is somewhat immature and though the priapium in general seems to have attained adult form, the toxactinium is only half grown, the bone soft and scarcely hooked. The exterior priapial bones seem to be the last parts of the organ to mature.

Named for Dr. Hugh M. Smith, Fisheries Commissioner to the Siamese Government.

There is a possibility that this species is not the one mentioned by Smith (1927). If it is not, two phallostethids must occur at Bangkok.

Neostethus Regan

REGAN, 1916, p. 2.

GENOTYPE.—*N. lankesteri* Regan.

Anal fin moderate. One spine in first dorsal fin. One or two unserrated ctenactinia projecting from the posterior part of the priapium. In the female, anus, oviduct, ureter, and abdominal fringe not in a groove. A pair of papillæ covering the oviduct and ureter openings. Lower jaw somewhat projecting. Head and nape presumably naked, but this not stated in description.

Neostethus lankesteri Regan

REGAN, 1916, pp. 2-14, Figs. 1-10, 12, Pls. I-IV. WEBER AND DE BEAUFORT, 1922, p. 382, Fig. 103.

Anal 15 or 16. First dorsal I. Second dorsal 5 or 6. Scales 34 to 36. A single long ctenactinium. Posterior end of priapium with comb-like projections. Total length about 30 mm. The known specimens come from the Muar River, Malay Peninsula, and from Singapore, in brackish water. Named for Sir E. Ray Lankester, British morphologist.

¹Since the above was in type Dr. Herre has described *Pandaka pygmaea*, a Philippine goby still smaller than *Mistichthys*.

***Neostethus bicornis* Regan**

REGAN, 1916, pp. 14-15, Fig. 11.

Anal 13 to 15. First dorsal I. Second dorsal ? Scales 35 to 37. Two ctenactinia. Posterior end of priapium without comb-like structure. The largest of the three known specimens, which were taken in brackish water at Kuala Langat, Malay Peninsula, is 25 mm. long and not wholly adult. It is thus impossible to tell the structure of the adult ctenactinia.

***Gulaphallus* Herre**

HERRE, 1925, p. 508.

GENOTYPE.¹—*G. eximius* Herre.

This genus appears to differ from *Neostethus* only in having two spines instead of one in the first dorsal fin. On this basis alone I should not hold the genus as distinct from *Neostethus*, but there may be other differing characters not apparent from the descriptions, and *Gulaphallus* should not be synonymized without actual comparison with material of the other genus.

Dr. Herre described *Gulaphallus* as new while unaware that Regan's material possessed the spinous dorsal. In his descriptions Dr. Herre has mentioned both the toxactinium and ctenactinium as present in *Gulaphallus*. In looking over his figures and my material of this genus, it is very evident that the bone Herre calls the toxactinium is not the homologue of the toxactinium of *Phenacostethus* and *Phallostethus*. The toxactinium in these two genera projects from the anterior end of the priapium and its base is covered by the pulvinulus. There seems little doubt that Herre's "toxactinium," which projects from the posterior part of the priapium, is exactly homologous with the ctenactinium of *Neostethus*. The bone called by Herre the ctenactinium may very well be the homologue of the second (shorter) ctenactinium of *Neostethus bicornis*. If this last be true, it would argue either for the transfer of *bicornis* to *Gulaphallus*, or the abolishment of the latter genus, unless, of course the adult *bicornis* be found to have characters warranting a special genus for that species. Then too the very similar, irregular, curved organ at the posterior end of the priapium of *Phenacostethus* might well be a ctenactinium, but I hesitate to so designate it without more detailed anatomical examination than has been possible.

***Gulaphallus eximius* Herre**

HERRE, 1925, p. 509, Pl. I, figs. 1-5, Pl. II, figs. 1-2.

Anal 15 to 17. First dorsal II. Second dorsal 7. Scales 56 to 58. Length (total ?) 35 mm. Mountain creeks at Santa Fé, Nueva Vizcaya Province, Luzon, Philippines.

¹Here designated for the first time

This form is remarkable for the small scales. With the next species, it is the largest of the Phallostethidæ.

***Gulaphallus mirabilis* Herre**

HERRE, 1925, p. 511, Pl. II, figs. 3-5.

Anal 17 or 18. First dorsal II. Second dorsal 7. Scales 36 to 38. These data are from Herre's description. The types, up to 33 mm. (total?) length, were from the mouth of the Ibo, a small mountain creek flowing into the Angat River, Bulacan Province, about 60 km. northeast of Manila, Luzon, Philippines.

Dr. Herre has very kindly sent me some hitherto unrecorded material of this species, consisting of 14 males and 15 females, the largest (a female) 27.5 mm. standard length (35 mm. total), from Molawin Creek, Los Baños, Luzon. In this material the scale number varies from 31 to 35, but aside from this there seem to be no differences of note. Herre did not mention that the scales are smaller and much more irregular anteriorly. Some difficulty is encountered in correctly ascertaining the number in the perhaps slightly enlarged row along the side-stripe, for the scales of the rows above and below frequently meet between those of the mid-side series. The scales are especially small and crowded in the pre-dorsal region. There are two small tuft-like pseudobranchiæ present, similar to those seen in the cyprinodonts allied to *Rivulus* and *Panchax*.

The colors, entirely unmentioned by Herre, are as follows: Myotomes not evident. A fine, median, dark line down the sides to the caudal base, rather obsolete forward. Scales above this line dark-edged, this more accentuated toward the mid-dorsal line, and absent or rapidly fading below the lateral stripe. Occiput black. A collection of large melanophores, forming a conspicuous black blotch, at the lower edge of the abdomen, at the mid-length of the abdominal fringe but not extending on it. This spot in most cases is over or a little posterior to a dark visceral patch (in formalin specimens). A fine dark line just above anal base, as in *G. eximius*. The colors are the same in both sexes.

***Mirophallus* Herre**

HERRE, 1926, p. 539.

GENOTYPE.—*M. bikolanus* Herre.

Anal moderate. Spinous dorsal fin entirely absent. Posterior end of priapium of a peculiar bulbous form. Toxactinium apparently absent and two ctenactinia present. The remarks under *Gulaphallus* concerning Herre's description of the priapial bones should be consulted. Nape and opercles scaly.

This is the only phallostethid so far known in which we can be reasonably sure that the external manifestation of a spinous dorsal is

absent.¹ Further, it appears to be unique in the scaled nape and opercles, but Regan did not describe these characters in his specimens.

***Mirophallus bikolanus* Herre**

HERRE, 1926, p. 540, Pl. III, figs. 1-6.

Anal 15. Dorsal 7. Scales 32. Length 27 mm. (total ?). Lake Bato, Camarines Sur Province, and Lake Lanigay, Albay Province, Luzon, Philippines. There is no mention of the abdominal fringe in this species, and it is not figured in the plate.

DISCUSSION

Five genera and seven species of Phallostethidæ are now known, three forms from brackish water in the Southern Malay Peninsula and Singapore, and four from freshwater streams in Siam and the Philippines. My friend, Dr. Deogracias V. Villadolid, of the College of Agriculture, Los Baños, Philippines, who was studying at Stanford when I began the present work, has written that he has recently collected phallostethids in brackish water in Manila Bay. We shall await with interest his report on them, particularly if life-history and ecological notes accompany it.

No doubt a number of new species and new generic types of these most remarkable little fishes remain to be discovered. They doubtless occur throughout the Malayan region and we may go so far as to predict that they will certainly be found in Borneo and Sumatra, probably in Java, and very possibly as far as Celebes, Timor, and Burma.

The greatest interest attaches to the observation of living phallostethids, particularly in regard to the use of the priapial structures. Dr. Smith has stated one species to be oviparous although he has not actually seen the breeding, but it would seem that the complicated structures present indicated viviparity.

Doubtless the larger phallostethids devour mosquito larvæ, but if they are as delicate in captivity as are their relatives the atherines, we can scarcely expect them to stand transport and to be of use as larvicide.

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¹See under *Phallostethus*.

(Description of *Protistius semotilus*, pp. 66-67.)

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AMERICAN MUSEUM NOVITATES

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A NEW MELANOTÆNIIN FISH FROM QUEENSLAND

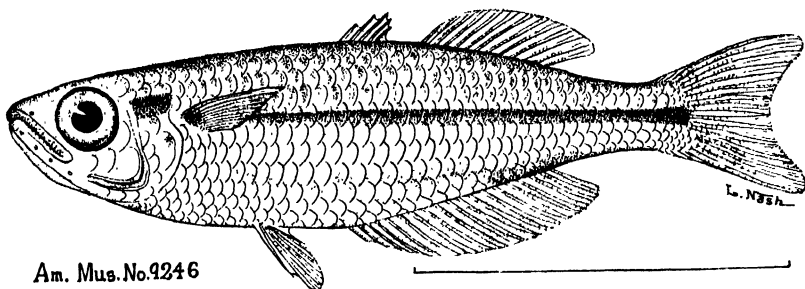
By J. T. NICHOLS AND H. C. RAVEN

Rhadinocentrus rhombosomoides, new species

The type, No. 9246 American Museum of Natural History, collected in the Babinda Creek drainage, northeast Queensland, Australia, October, 1921, by H. C. Raven, is 42 mm. long to base of caudal. Depth in this length, 3.6; head, 3.5. Eye in head, 2.6; snout, 3.3; maxillary, 2.2; interorbital, 2.4; greatest breadth of body, 2.4; depth of peduncle, 2.4; its length, 1.7; pectoral, 1.4; ventral, 1.7; longest dorsal spine, 4; longest dorsal ray, 3; longest anal ray, 2.2; caudal lobe, 1.2.

Dorsal rays, V-13; anal rays, 19; none of the fin-rays stiff or pungent. Scales, 38; 11 rows between 1st dorsal and ventral.

Head flat across the top, narrowed below; body well compressed; line from snout to first dorsal almost straight. Lower jaw slightly included when the mouth is



Am. Mus. No. 9246

Fig. 1. *Rhadinocentrus rhombosomoides*, new species.

closed, its corners fitting into a re-entrance to either side of the expanded premaxillaries. Maxillary somewhat oblique, extending to under the front of the pupil, set with fine teeth which are exposed when the mouth is closed. Teeth rather uniformly small in bands on jaws and vomer. Gill-rakers short and blunt, ten or eleven on the lower limb of the first arch. Silvery in life. Color in alcohol brownish, paler below. A black stripe from the eye to the base of the caudal, broadest on the head and posteriorly.

This fish is quite unlike the type of *Rhadinocentrus*, *R. ornatus* Regan 1914, Trans. Zool. Soc., XX, p. 280, Pl. xxxi, fig. 1. It looks very like the young of *Rhombosoma novæ-guinææ* (fig. 6 of the same plate), but none of the fine rays are pungent. The genera allied to *Melanotænia*

are probably close, and presence or absence of pungent spines is one of the most definite, tangible criteria for separating them. The type is the largest of five specimens of our new species (down to 32 mm.) which were readily picked out of a considerable series of large and small *Melanotænia nigrans* with the same data, by means of their lack of spines, larger mouth, lesser depth (for individuals of comparable size).

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A NEW MAMMALIAN FAUNA FROM THE FORT UNION OF SOUTHERN MONTANA

BY GEORGE GAYLORD SIMPSON

The discovery of a new mammalian fauna in the Paleocene is of considerable interest and importance. Previous knowledge of the mammals of the Fort Union Formation has rested almost altogether on collections made at a single locality in Sweetgrass County, Montana.¹ Although equivalent to the Torrejon of New Mexico in age, the Sweetgrass fauna is of quite distinct facies and is rich in forms not known from the Torrejon. Similarly, the present fauna is probably of nearly or quite the same age as that from Sweetgrass County but is of quite different facies, as confirmed by Dr. Gidley who kindly compared it with the rich and largely undescribed collection in his care.

The discovery of this fauna and its prompt announcement are due to Dr. J. C. F. Siegfriedt of Bear Creek, Montana. The first mammal tooth found, said to be a molar of *Tetraclaenodon*, was found by Dr. Siegfriedt Nov. 5, 1927, and received some attention in the press as it was at first believed to be a primate. On May 10, 1927, Dr. Siegfriedt wrote to Professor Henry Fairfield Osborn regarding his discovery and he later sent his own collection, much enlarged since the first discovery, to this museum where it was cleaned from the stubborn matrix, cast, and photographed. From September 10th to 16th, 1927, Barnum Brown visited this locality and with Dr. Siegfriedt's coöperation examined the occurrence and made a characteristic collection of mammal jaws and teeth. He also shipped to New York a quantity of matrix from which an even larger number of specimens has since been recovered. It is hoped to continue work in this field on a more intensive scale during 1928.

The fossils come from the "bone" layer, so called because of its argillaceous nature and not because it is literally bone-bearing, in the roof of the Eagle Mine, about one mile south of Bear Creek in the Red Lodge Coal Field, Carbon County, in southern Montana. The deposit is just

¹See especially:

Douglass, E. 1908. Vertebrate Fossils from the Fort Union Beds. An. Carnegie Mus., V, 11-26.
Gidley, J. W. 1909. Notes on the Fossil Mammalian Genus *Ptilolus*, etc. Proc. U. S. Nat. Mus. XXVI, 611-26.
... 1915. An Extinct Marsupial from the Fort Union, etc. Ib., XLVIII, 395-402.
... 1923. Paleocene Primates of the Fort Union, etc., Ib., LXIII, 1-38.

above coal vein No. 3 of the local field.¹ Mr. Brown states that this coal vein is about 1500 feet above the base of the Fort Union as determined lithologically according to the accepted boundary.

The fauna represented by the American Museum specimens is as follows:

INSECTIVORA

Nyctitheriidae, new family.

Protentomodon ursivalis, new genus and species.

Pantolestidae

?*Pentacodon* cf. *inversus* Cope.

Adapisoricidae

Leipsanolestes siegfriedti, new genus and species.

PRIMATES

Plesiadapidae

?*Plesiadapis* sp.

Tarsiidae

Carpolestes nigridentis, new genus and species.

CREODONTA

Oxyclaenidae

Thryplacodon pseudarctos, new species.

PLACENTALIA INCERTÆ SEDIS

Planetetherium mirabile, new genus and species.

There are also a number of unidentified isolated teeth, especially incisors, and fragmentary jaws. In the same layer occur many remains of freshwater molluscs, fishes, turtles, champsosaurs, and crocodiles.

In age the fauna is clearly Paleocene and post-Puerco. There is some suggestion that it is later than the Sweetgrass County mammalian fauna from the same formation. *Plesiadapis* and *Thryplacodon* have not hitherto been recorded earlier than the Tiffany—Clark Fork, but neither reference is sufficiently certain to be impelling. *Protentomodon*, *Leipsanolestes*, and *Carpolestes* also find their closest allies in definitely post-Torrejon faunas, but their apparent absence in the Torrejon and Sweetgrass County Fort Union may well be due to lack of discovery only, as all are minute. *Pentacodon* is a Torrejon genus, but the reference is not certain and members of the same family with very similar molars also occur in the lower and middle Eocene.

Large animals and especially ungulates are so far noticeable by their almost total absence. The fauna is that of a heavily forested and swampy region.

¹See Woodruff, E. G. 1909. The Red Lodge Coal Field, Montana. U. S. Geol. Surv., Bul. 341, p. 92-107.

The drawings in this paper are by John German.

Nyctitheriidae, new family

PROVISIONAL DIAGNOSIS.—Antemolar teeth relatively little specialized. Symphysis long and slender, not fused. P_4 not molariform. Lower molars tuberculo-sectorial, Trigonid notably higher than talonid, with slender, sharp, angulate cusps. Paraconid present, but smaller than other trigonid cusps. Talonid low, basined, with strong entoconid and hypoconid but hypoconulid sometimes small or absent. Heel of M_3 little if any longer than that of preceding molars. Upper molars basically tributubercular, but with hypocone. Paracone and metacone not definitely lambdoid.

TYPE.—*Nyctitherium* Marsh, Wasatch and Bridger.

REFERRED GENERA.—*Entomacodon*, Wasatch and Bridger; *Centetodon* and *Myolestes*, Bridger; *Protentomodon*, Fort Union; and possibly some other Eocene and perhaps Oligocene genera.

Various genera of this group have been referred to the Talpidæ, Chiroptera, Zalambdodonta, Leptictidæ, and Soricidæ. So far as known, however, all show definite differences from any of these groups. It seems probable that most or all of them are soricomorphs. Matthew in 1909 referred them to the Talpidæ, although questioning the correctness of this reference. Later he abandoned this view and referred *Nyctitherium* to the “?Soricoidea or Chiroptera.” In either case they represent a new family, the structure of the antemolar teeth excluding them from the Soricidæ, the molars, especially the uppers, from either Talpidæ or Soricidæ, and the character of the anterior part of the mandible from any family of chiropterans.

It is not certain that all the poorly known genera provisionally referred to this family are really very close relatives of *Nyctitherium*, but the structure of the lower molars is so similar that such a convenient arrangement has much to commend it. It seems possible in the absence of really adequate evidence that the nyctitheriids have much the same relationship to the soricomorphs as that of the leptictids to the erinaceomorphs.

Protentomodon ursirivalis,¹ new genus and species

(Figure 1)

TYPE.—A. M. No. 22164, left ramus with M_{2-3} .

TOPOTYPE.—A. M. No. 22173.

CHARACTERS.—On M_{2-3} the trigonid is lofty, elevated well above the heel, its cusps acute and angulate. The metaconid is anterointernal to the protoconid and is large, although on M_3 and probably also M_2 it was apparently not quite as high as the protoconid (it is broken or worn off in the type but another specimen, probably refer-

¹πρῶτον, first; ἔντομον, insect; ὀδός, tooth—i.e. an ancient insectivore. *Ursus*, bear; *rivalis*, creek—from the locality.

able to this genus, shows it clearly). Although distinct and pointed, the paraconid is low and is median on the tooth, united by a sharp ridge to the protoconid. The heel of M_2 is short, low, about as wide as the trigonid. It has a basin surrounded by a sharp raised rim which is continuous and bears the entoconid, hypoconulid, and hypo-

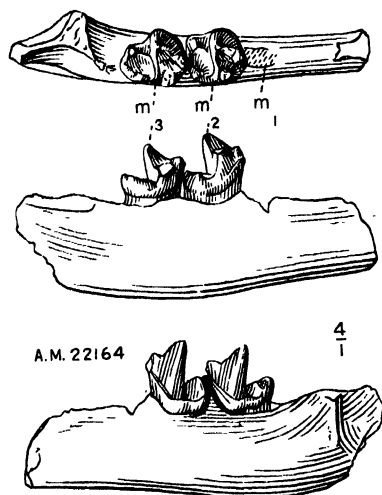


Fig. 1. *Protentomodon ursirivalis*, new genus and species. Crown, inner, and outer views of type. Four times natural size.

conid as elevations of about equal prominence. The hypoconulid is somewhat closer to the hypoconid. The heel of M_3 is narrower and longer and its hypoconulid is truly median and is elevated above the other cusps, which are indistinct. On both posterior molars a cingulum runs sharply downward and externally from near the paraconid and then around the external base of the protoconid. The jaw is very slender and elongate, with the posterior mental foramen beneath M_1 .



A. M. 22175

Fig. 2. ?*Pentacodon* cf. *inversus* Cope. Crown view of M^1 right. Four times natural size.

Pantolestidae

?*Pentacodon* cf. *inversus* Cope

(Figure 2)

A. M. No. 22175, a right upper first molar, is tentatively referred to the Torrejon genus *Pentacodon*. It is a transversely elongate tritubercular tooth with sharp angulate cusps. Paracone and metacone are subequal and slightly connate at the base. There is a sharp external cingulum, somewhat expanded opposite the metacone, but without a definite metastyle or mesostyle. The parastyle is very small and almost directly anterior to the paracone. There are distinct, equal conules. The protocone is large, equal to the external cusps in height, and crescentic. Its apex points slightly forward and it has a long internal slope. There is a small anterior cingulum not forming a definite protostyle

("cetocone" of Teilhard). The posterior cingulum is wide, basined, and projects well inward. The highest point of its rim corresponds to the hypocone although it is not definitely free and cusp-like. It is low on the crown.

This tooth is referred to the Pantolestidæ chiefly on the basis of its fairly close resemblance to *Palaeosinopa* of the Wasatch. It is referred to *Pentacodon* because this is the only genus of similar age so far known in this family and because M_1 agrees as far as can be determined from the imperfect material. There are two species of *Pentacodon* in the Torrejon, *P. inversus* and a second, undescribed, more robust species. The upper teeth of *P. inversus* are unknown, but there is a specimen of the other species which appears to show its upper dentition, although in a poor state of preservation. There is an admixture of several genera, but the upper jaw fragment probably is naturally associated with the lower jaw of *Pentacodon* sp. ined. for it is of appropriate size, could not belong with the other genera present, has the same peculiarly enlarged P^4 , and is closely similar to *Palaeosinopa* which was already believed on other grounds to be an ally of *Pentacodon*. The Fort Union tooth is smaller than the corresponding one of this specimen in the same ratio as the lower teeth of *Pentacodon inversus* are smaller than those of *P. sp. ined.* The Fort Union specimen therefore cannot be proven to be distinct from *P. inversus*, although directly comparable material will probably show that it is different specifically.

The resemblance of this tooth to the Oxyclænidæ on the one hand and to the Leptictidæ on the other and the absence of good figures of pantolestid upper molars in the literature may lead to this reference's being questioned. There are excellent examples of the pantolestid upper dentition in our collection, however, and direct comparison shows that the Fort Union tooth differs as much from oxyclænids and leptictids as do the other pantolestids and in just the same way.

Adapisoricidæ

Two groups of Paleocene and Eocene mammals have been referred to the Menotyphla. One of these, the Plesiadapidæ, has little actual resemblance to recent menotyphlans but has molars of tarsiod type accompanied by greatly enlarged median teeth and reduction of the other ante-molar teeth. The morphological grounds for referring this family to the Menotyphla seem very equivocal, and I am inclined to agree with Stehlin, Gidley, and others in considering them as true primitive primates. There are a few minute forms, however, especially *Adapisorex* of the Thanetian (upper Paleocene), *Entomolestes* of the

Wasatch and Bridger (lower and middle Eocene), and *Leipsanolestes*, new genus, of the Bear Creek Fort Union (middle or upper Paleocene), which show a positive morphological resemblance to the Tupaiidæ and no differences which separate them markedly from this recent family. In view of the somewhat inadequate nature of the material, these genera are here retained in the family Adapisoricidæ, but further discovery may well show that this family is not distinct from the Tupaiidæ.¹ The hope of throwing further light on the early history of this very important group is one of the greatest incentives for further collecting at the Bear Creek locality.

***Leipsanolestes siegfriedti*,² new genus and species**

(Figure 3 and 3A)

TYPE.—Amer. Mus. No. 22157, part of right ramus with M_{2-3} .

TOPOTYPES.—Amer. Mus. Nos. 22158, 22177, 22178, 22174, 22179.

CHARACTERS.—Lower molars with trigonid little elevated above talonid. Paraconid small, internal, not elevated but forming the end of an anterior ridge from the protoconid. Protoconid and metaconid acute, opposite, subequal or metaconid

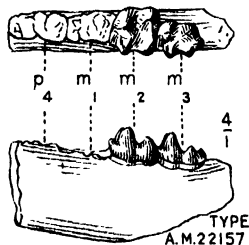


Fig. 3. *Leipsanolestes siegfriedti*, new genus and species. Crown and inner views of type. Four times natural size.

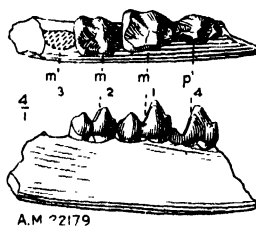


Fig. 3A. *Leipsanolestes siegfriedti*, new genus and species. Crown and inner views of A. M. No. 22179. Four times natural size.

slightly larger on M_{2-3} . M_{1-2} without definite hypoconulid but with strong hypoconid and entoconid, the latter much larger but not as high as the metaconid. M_3 with distinct median hypoconulid, posterior to hypoconid and entoconid, nearer the former in height, the entoconid being higher, as in other molars. P_4 submolariform, but compressed, with small metaconid and rudimentary paraconid. Internal part of heel of P_4 very narrow, with shallow basin, rising to a single posterior point. External part of heel a long, steep slope outward. Size of species minute, $M_{2-3}=3.1$ mm. in type.

¹*Adapisoriculus* of the Thanetian has nothing to do with this group, being a didelphid as suggested by Teilhard and confirmed by a study of the known material through the kindness of Professors Boule and Depéret.

²*Λειψάνοι*, remnant; *Λυγρός*, robber—in allusion to the fragmentary nature of the material. The species is dedicated to Dr. J. C. F. Siegfriedt, discoverer of the fauna.

Plesiadapidae

?Plesiadapis species undetermined

(Figure 4)

This genus is apparently represented by a third lower left molar. This tooth agrees very closely with *Plesiadapis gidleyi*¹ save in being a little larger. It differs from *Pronothodectes matthewi* Gidley of the Sweetgrass County Fort Union in being nearly twice as large and more complex than M₃ of this species, although the difference in complexity may be due in part to wear in Dr. Gidley's material. In size it agrees most closely with the very badly preserved plesiadapid M₃ from the Paskapoo.² The presence of this tooth is one of the facts which suggest but do not prove that the Bear Creek fauna is later in age than that from Sweetgrass County.



Fig. 4. ?*Plesiadapis* sp. indet. Crown view of M₃ left. Four times natural size.

Tarsiidae

Carpolestes nigridens,³ new genus and species

(Figure 5)

TYPE.—Amer. Mus. No. 22159, right ramus with P₄, M₁₋₂.

CHARACTERS.—P₄ is high, laterally compressed, trenchant. Along the ascending anterior edge there are five projections below each of which there is a short vertical ridge on both lateral faces. The apex is broken in the type, but was apparently formed by a sixth, more prominent cusp. Back of this was another accessory cusp in the same longitudinal series and at the posterior end is another cusp, apparently the eighth, on about the same level as the paraconid of M₁. The base of the tooth extends far down, especially externally. There is a discontinuous cingulum internally, rising to a median point.

The trigonid of M₁ is much modified and continues the shearing edge of P₄. The paraconid is directly anterior to the protoconid and nearly as high, and both are median on the tooth. The metaconid is small and is on the posterointernal slope of the protoconid. There is a small basined heel, the inner rim lower than the outer, the fairly prominent hypoconid connected by an oblique crest with the metaconid. M₂ has an unusually small basined trigonid, considerably narrower and shorter than the talonid. Paraconid and metaconid are internal, with connate bases, the paraconid somewhat the smaller. The protoconid is lower than the internal cusps. The heel is large and well basined, with distinct, subequal hypoconid and entoconid, but apparently no hypoconulid. M₃ is absent, but its alveoli show it to have been a small tooth with an elongate heel.

¹*Nothodectes gidleyi* Matthew. The recent work of Father Teilhard de Chardin seems to leave no grounds for generic separation of *Nothodectes* and *Plesiadapis*.

²Amer. Mus. Novitates No. 268, p. 4. I was in Europe when the figures were prepared for this paper and they were accidentally mislabeled. In Fig. 4, C is M₂ right, broken posteriorly, and F is M₁ left.

³*Kapros*, fruit; *ληρός*, robber—in allusion to probable habits and in sympathy with *Carpodaptes*, a close relative. *Niger*, black; *dens*, tooth—literally true of all these coal fossils.

The coronoid arises outside the posterior end of M_3 . The horizontal ramus is rather deep and short, with the posterior mental foramen between P_3 and P_4 . The angle is largely preserved and is not inflected, but projects downward and backward.

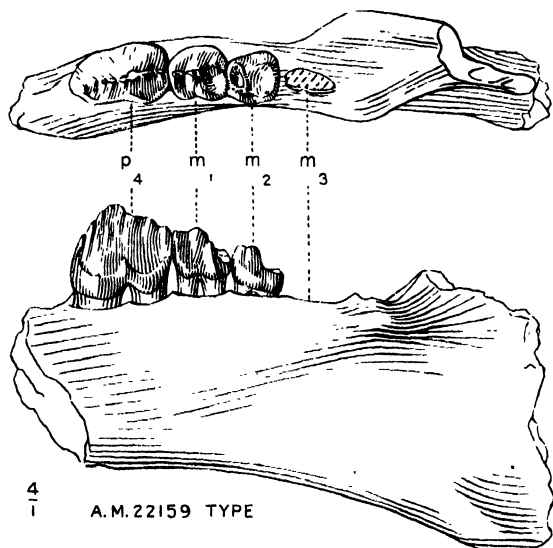


Fig. 5. *Carpolestes nigridens*, new genus and species. Crown and inner views of type. Four times natural size.

There is only one other known genus which is readily comparable with this odd animal: *Carpodaptes* of the upper Paleocene (Tiffany = Thanetian) of southwestern Colorado.¹ The resemblance between the two is so striking that they must be closely related. Besides its greater size, *Carpolestes* differs from *Carpodaptes* chiefly in the more specialized P_4 , with a greater number of cuspules, the last one less distinct, less definitely heel-like, higher on the crown. M_{1-2} are almost identical in structure. In *Carpodaptes* M_3 is known and it has an elongate bilobed heel of typical tarsioid type. Despite their clear affinity with each other, *Carpolestes* and *Carpodaptes* are very peculiar and their relationships with other established genera are not obvious.

At first sight they offer a striking resemblance to certain fossil South American Cænolestoid marsupials, but a study of the molar and other characters shows that this is entirely superficial. Trenchant grooved² teeth of this general type have been evolved quite independently at least

¹Matthew, W. D. & Granger, W. 1921. New Genera of Paleocene Mammals. Amer. Mus. Novitates, No. 13, p. 6.

four times: In the multituberculates (P_{2-4} in Plagiaulacidæ, P_1 in Ptilodontidæ), in the Cænolestoids (Abderitinæ and Polydolopidæ, M_1), in the Macropodidæ (Several genera, P_3), and in *Carpolestes* and *Carpodaptes* (P_4). In the first three cases this character has often been seized on as indicative of special affinity, although the shearing teeth are not homologous and the resemblance not very close. In the present case we can fortunately avoid such an error from the beginning. This striking exemplification of convergent evolution of a single character must be due to community of food habits, probably to a diet of roots, grasses, seeds, small nuts, and fruits.

In describing *Carpodaptes*, Matthew and Granger said, "Molars fundamentally of tarsioid type, but considerably specialized in various respects," and as an added remark, "This form cannot be definitely assigned to any family or order; it may be a primate or a menotyphlan insectivore, or neither."

Aside from the modification for shear, which affects only the trigonid of M_1 , the molars are of a definite, ordinally specialized type which among all mammals, living or extinct, occurs only in primates or in certain forms sometimes referred to the Menotyphla but more like the Eocene primates and in any event essentially forming a broad unit with the latter. If this were a less exact sort of resemblance or a type of structure occurring in two or more unrelated groups, it could not be considered as special evidence of affinities, but since the contrary is true it can hardly be otherwise considered. Specifically the resemblance is with the Plesiadapidæ and the Tarsiidæ (Anaptomorphidæ) of the Paleocene of North America and Europe.

Carpolestes may possibly have a gliriform lower incisor, like some plesiadapids, although this is uncertain. *Carpodaptes* had three small, one rooted, button-like premolars in front of the enlarged shearing tooth. The anterior one was crowded externally by the large canine, and there was no truly gliriform incisor, none with the root extending back beneath the premolars. The presence of the canine, reduction of premolars in size but not in numbers, and absence of a very long-rooted incisor clearly excludes this genus from the Plesiadapidæ, and *Carpolestes* is certainly closely allied, whether it had a gliriform tooth or not. Enlarged incisors do occur among tarsiids, although not characteristic of the family.

As further evidence of the tarsiid nature of *Carpolestes* and of its entire distinction from the convergent cænolestoids are to be cited the short jaw with robust symphysis, the tarsioid and *non-inflected* angle (almost completely preserved in the type), and the fact that the stages of

transition from a normal P_4 to this highly specialized one are clearly shown in known Paleocene and Eocene tarsiid genera. In several Eocene forms P_4 is much enlarged and shearing, although not much compressed or grooved, e.g., in *Tetonius*, *Absarokius*, *Uintanius*. In the Sweetgrass Fort Union *Elphidotarsius*, which in the known parts furnishes a good morphological ancestry for *Carpodaptes* and *Carpolestes*, P_4 is more compressed and has four apical cusps nearly in an anteroposterior series and a low heel with one cusp, while the trigonid of M_1 is also markedly compressed. In *Carpodaptes* P_4 is larger, slightly more compressed, the four apical cusps are in a more nearly linear series, and the heel is higher and narrower. In *Carpolestes* P_4 is still larger, the number of cusps is greater, and heel is even narrower and higher than in *Carpodaptes*. In all the molar structure is almost identical, save that in the most strongly trenchant types the paraconid of M_1 becomes more directly anterior to the protoconid.

Perhaps the greatest peculiarity of *Carpodaptes*, in view of its manifest relationship to the tarsiidæ, is the character of the small button-like P_{1-3} which is also convergent towards the cænolestoids. But these premolars are often reduced in size in the Tarsiidæ and the character is certainly not of family value.

With due reservation for the possible influence of future discoveries, the evidence in hand seems fully to warrant the positive conclusion that *Carpolestes* and *Carpodaptes* represent an aberrant early stirps of the Paleocene and Eocene group commonly referred to the Tarsiidæ.

Oxycenidæ

*Thryptacodon pseudarcetos*¹, new species

(Figure 6)

TYPE.—A. M. No. 22176, isolated M^2 right.

CHARACTERS.— M^2 is subquadrate, consisting of a trigon of low, blunt cusps, surrounded by a strong, continuous but irregular cingulum which rises to form a large hypocone posterior and somewhat internal to the protocone. The cusps of the trigon are united by ridges and enclose a triangular basin. The ridge between paracone and metacone is low and sharp, but the union of protocone with the external cusps is chiefly by the conules, which are small but distinct. The transverse space occupied by the metaconule is somewhat greater than that of the paraconule, but the former is no higher. In our specimen it is distinctly double. It does not project posteriorly and is far from the edge of the tooth. The hypocone is as high as the trigon cusps. The enamel of the crown is coarsely rugose.

¹*ψευδής*, false; *ἀρκτος*, bear—in allusion to the somewhat bear-like molars. On *Thryptacodon* see Matthew, 1915, Bul. Amer. Mus. Nat. Hist., XXXIV, p. 7-13.

This tooth differs from the homologous ones in the two Wasatch species in many details. Most marked is the fact that in the latter the metaconule is single and enlarged, breaking the symmetry of the trigon. The trigon cusps are also more separate and the ledge around them narrower, but the resemblance to *T. pseudarctos* is certainly close and there is insufficient evidence in this one tooth for generic separation. *Thryptacodon* also occurs in the Tiffany, upper Paleocene, but the Tiffany form is equally distinct from the present one.

Arctocyonides Lemoine from the Thanetian of Cernay-les-Reims is very closely allied to *Thryptacodon* Matthew, and the differences may not be of more than specific value. In some respects the Fort Union tooth is closer to the M² of *Arctocyonides* figured by Teilhard (Ann. de Paleont., XI, Pl. I, fig. 23) than to any species certainly referred to *Thryptacodon*, but until better material is available it seems best to place it in the American genus.



Fig. 6. *Thryptacodon pseudarctos*, new species. Crown view of type, M² right. Twice natural size.

Placentalia Incertæ Sedis

Planetetherium mirabile,¹ new genus and species

(Figures 7-9)

TYPE.—Amer. Mus. No. 22162, left ramus with P₃₋₄ and M₁.

PARATYPE.—Amer. Mus. No. 22161, left ramus with P₄ and M₁₋₃.

TOPOTYPES.—Amer. Mus. Nos. 22151, 22165, 22170.

CHARACTERS.—P₃ is submolariform, with the trigonid sharply compressed laterally trenchant, about the same height as the molar trigonids. The paraconid is small and anterointernal to the protoconid. The metaconid is represented only by an almost imperceptible rudiment, posterointernal to the protoconid and lower on the crown than the paraconid. The heel is shorter and narrower than in the more fully molariform teeth and is basined.

The trigonid of P₄ is but little elevated above the talonid and has three distinct cusps. The protoconid and metaconid are nearly equal and opposite. The paraconid is slightly smaller and is a little external relative to the metaconid, but not median on the tooth. The heel is slightly broader than the trigonid, nearly as long, and is deeply basined. The entoconid is distinctly higher than the hypoconid and has a minute accessory cusp, or incipient duplication, immediately anterior to it. A small median hypoconulid is present. The enamel of P₄ and of the true molars is crenulated, especially in the talonid basins, the degree of crenulation varying somewhat in different individuals.

M₁₋₂ are subequal. The trigonids are formed by the opposite and nearly equal protoconid and metaconid, the paraconid being represented only by a minute median

¹πλανήτης, wanderer; θηρίον, beast. *Mirabilis*, strange.

cusps on the anterior border of the tooth between the protoconid and metaconid. On M_1 of the paratype even this vestige can hardly be distinguished, possibly because of wear. The heels are like that of P_4 but somewhat larger.

M_3 is slightly smaller than the preceding tooth but its trigonid has the same structure. The heel has the entoconid and hypoconid united by a low ridge and the entoconid slightly the larger, as in the preceding teeth, but the heel is elongated, with the hypoconulid extending far back of the talonid basin as a spur.

As shown by alveoli in the type, P_{1-2} were present and P_2 , at least, was about as long as P_3 . None of the incisor roots extends back beneath the premolars and there is no diprotodont or rodent-like specialization.

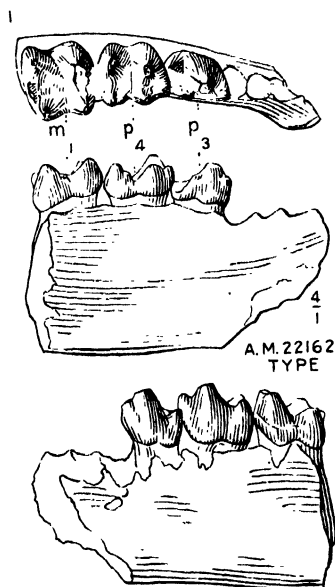


Fig. 7. *Planetetherium mirabile*, new genus and species. Crown, inner, and outer views of type. Four times natural size.

Two upper teeth, P^4 (Amer. Mus. No. 22168) and probably M^2 (Amer. Mus. No. 22160) are referred to this genus. The bases for this reference of isolated teeth are agreement in size, correct occlusional possibilities, similar crenulation of the enamel and the more general facts that *Planetetherium* is the most abundant genus in the collection and that no other known from lower jaws could include these upper teeth. The association is not proven, but it is highly probable.

P^4 has paracone and metacone separate, equal, but with connate bases. Parastyle and metastyle are small but distinct and do not project externally. There is no external cingulum. The protocone is lower than the external cusps and projects anterointernally. It is united to the paracone only by a low ridge and there are no conules. The apex of the protocone is inclined forward. M^2 has similar equal, sub-conical paracone and metacone and a lower, blunt protocone inclined anteriorly.

The conules are distinct and tend to form ridges uniting the protocone to the external cusps. There is a strong metastyle posteroexternal to the metacone and from it a sharp nodulated cingulum extends around the external and anterior sides of the tooth, forming a small parastyle immediately anterior to the paracone. There is also a narrow posterior cingulum, not extending onto the base of the protocone.

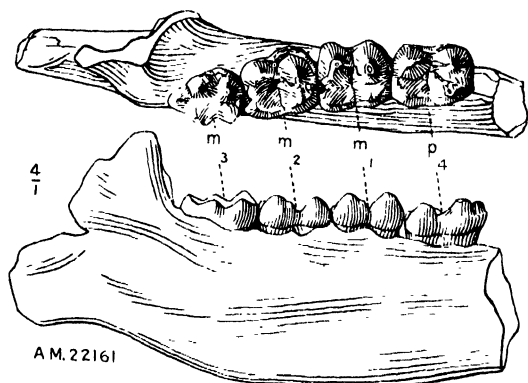


Fig. 8. *Planetetherium mirabile*, new genus and species. Crown and inner views of paratype. Four times natural size.

Planetetherium is the most abundant element in the Bear Creek fauna so far as may be judged by the present collection. Its relationships are obscure and I do not know any genus with which detailed comparison is possible. At first sight the presence of four molariform teeth might suggest the Marsupialia, but this is readily shown to be an erroneous impression. In the type, P_1 is slightly less worn than P_3 and belongs to the same series in regard to degree of protrusion. In the paratype P_4 is slightly less worn than M_1 and is at a definitely lower level, not belonging to the molar series in regard to protrusion. These facts, confirmed by all of our material, seem to prove beyond reasonable doubt that this tooth was erupted after M_1 , that it belongs to the premolar series, and that it cannot be either the first true molar or the last deciduous premolar—and hence that the animal cannot be a marsupial. P_4 is not fully molariform and in molarization as well as in indications of relative time of eruption it agrees very closely with many placentals in which the posterior premolars are becoming molariform. There is no more reason for referring *Planetetherium* to the marsupialia on this ground alone than for similarly treating *Tetracænodon*, for instance.

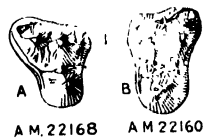


Fig. 9. *Planetetherium mirabile*, new genus and species. A, P_4 right. B, M_2 left. Four times natural size.

The molar structure is equally placental. No molars at all close to these morphologically are known in any group of marsupials. Among placentals similar upper and lower molars occur in Paleocene or Eocene forms belonging to at least four orders: Primates, Insectivora, Creodonta, Condylarthra. This widespread occurrence of the same general molar structure combined with the many peculiarities of *Planetetherium* in detailed generic character make it impossible to assign it definitely to any order or family at present and it must be left as a placental of uncertain affinities until more evidence is forthcoming.

INCISORS

(Figures 10-14)

In the same bed as the teeth and jaws described above there occur many isolated incisors. These cannot be definitely classified or correlated with cheek teeth as yet, but they are of some importance morphologically and seem to warrant brief descriptions and figures.

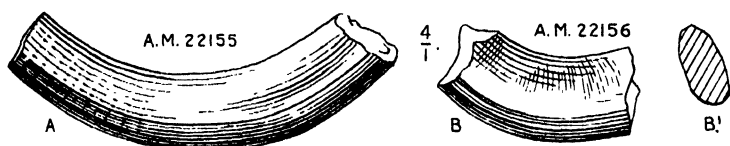


Fig. 10. Incisors. A, More slender, less strongly curved gliriform type. B, Stouter, more strongly curved gliriform type. B', Same as B, end view. Four times natural size.

A number of these are truly gliriform, arcuate, rootless or nearly so, with limited enamel band. Although rodent-like, they probably did not belong to rodents, as these did not arrive in America until the beginning



Fig. 11. Incisor. Four times natural size. Natural facet of wear preserved, to right in figure. Four times natural size.

of the true Eocene (Wasatch) so far as known. Furthermore they are not closely similar to Eocene rodent incisors in detail but resemble the incisors of *Eucosmodon*, a multituberculate, more nearly. They probably belong to multituberculates, although not to any otherwise known species of *Eucosmodon*. Cheek teeth of multituberculates are quite lacking in

the collections so far, and it is possible that these incisors, or some of them, belong rather to forms similar to the plesiadapids or tarsiiids. The slightly larger, more arcuate incisors (Fig. 10B) are very like some of the "chryomyoid" incisors from the European Eocene figured by Stehlin.

The next three incisors figured belong to insectivores or primates. One, resembling a plesiadapid lateral upper incisor, has a hook-like main cusp with a posterior basal cuspule and a suggestion of an antero-internal basal cusp (Fig. 12A). Another, (Fig. 12B) probably a median

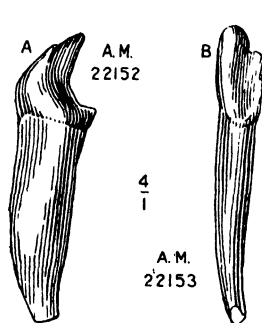


Fig. 12.

Fig. 12. Incisors. Four times natural size.

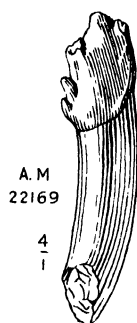


Fig. 13

Fig. 13. Incisor. Four times natural size.



Fig. 14

Fig. 14. Incisor cf. *Labidolemur*. Twice natural size.

incisor, is less recurved, without a basal cusp, but with a strong external accessory cusp. The third (Fig. 13) has an excavated posterior surface, without a basal cusp, with one accessory cusp and a suggestion of a second below the main apex on the median side and three distinct cusps or decreasing size down the lateral side.

A last type of incisor (Fig. 14) has a long, closed, enamel-free root and a completely enameled, pointed, upward curved crown with a flat inner surface, convex outer surface, and concave upper working face. This closely resembles the lower incisor of *Labidolemur soricoides* from the Tiffany and is probably related if not actually representative of the same genus. No cheek teeth resembling those of *Labidolemur* are as yet present in our collection.

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56.1.2 (118:73W)

STONES OF CELTIS IN THE TERTIARY OF THE WESTERN UNITED STATES¹

BY EDWARD W. BERRY

In 1909 Professor Cockerell described what he considered to be the seed of a spurge (Euphorbia) as *Tithymalus willistoni* from the "Loup Fork Miocene" of Long Island, Kansas.² Five years later this author described a second species from the Eocene (Wasatch or slightly older) of Clark's Fork Basin, Wyoming, which he called *Tithymalus phenacodorum*,³ and in connection with this he published a drawing of the former species, which had not before been figured. More recently Chaney has described the fruit of *Celtis hatcheri* from the White River Oligocene of South Dakota.⁴

In 1884 the late John B. Hatcher made a large collection of silicified fruits and seeds from the "Loup Fork Miocene" of Phillips County, Kansas. These were deposited in the U. S. National Museum where they have lain undescribed until the present time. More recently Mr. A. W. Etnyre has sent in similar silicified material from the undifferentiated Tertiary of eastern Colorado (Township 6 N., Range 44 W., Kit Carson County). Part of these collections have already been described as a new species belonging to the genus *Lithospermum* of the family Boraginaceæ.⁵ A considerable part of the remainder of both the Hatcher and Etnyre collections represents what I consider to be the stones of a species of *Celtis* (Ulmaceæ) and these are identical with what Cockerell called *Tithymalus willistoni*.

I am indebted to Chester A. Reeds of the American Museum of Natural History for the loan of the type of *Tithymalus phenacodorum* Cockerell (a single specimen), to Junius Henderson Curator of the Museum of the University of Colorado for the type of *Tithymalus willistoni* (comprising 2 specimens), and to Wm. J. Sinclair of Princeton University for several specimens of *Celtis hatcheri*. I have seen several hundred

¹Published by permission of the Director, U. S. Geological Survey.

²Cockerell, T. D. A. C. *Torreyia*, vol. 9, p. 119, 1909.

³Cockerell, T. D. A. C. *Idem*, vol. 14, p. 137, 1914.

⁴Chaney, R. W. *Carnegie Institution Publ.* 349, p. 54, pl. 1, fig. 8, 1925.

⁵Berry, Edward W. *U. S. Natl. Museum Proc.* (in press)

specimens of the fossil in all sizes, and a considerable collection of Recent Euphorbia seeds and Celtis stones for comparison with the fossils.

The study of this material leads to the conclusion, for reasons given in the following paragraphs, that Professor Cockerell was mistaken in identifying his material with Tithymalus of the Euphorbiaceæ, although it does show a striking superficial resemblance to the seeds of some of the spurges. *Tithymalus willistoni* becomes *Celtis willistoni* and is described and illustrated in somewhat greater detail below. *Tithymalus phenacodorum* Cockerell from the "Wasatch or slightly older Eocene" of Wyoming becomes *Celtis phenacodorum*, and it is very likely that *Celtis hatcheri* Chaney of the South Dakota Oligocene should be regarded as a synonym of that species, although I am not certain of this last point. Both are the same size and have the same form, but the single known specimen of *Celtis phenacodorum* is rugose, whereas in the vast majority of the very numerous stones of *Celtis hatcheri* the corresponding rugosities are but faintly developed.

Chaney interpreted the latter (op. cit., p. 54) as the complete fruits with the thin fleshy outer layer shrunk by drying and thereby thrown into reticulate wrinkles, but I believe that he was mistaken in this, and that the fossils represent the stones from which the fleshy layer had disappeared before fossilization, because the wall is but one layer thick instead of two as it should be if Chaney's interpretation was correct. Moreover *Celtis* fruits, even in arid regions so far as I have observed, and I have collected them in both North and South America, usually lose the flesh from the stones naturally by drying and abscission or by the digestive juices of the birds which compete for the relatively scanty food supply in such regions.

Of course I realize that smoothness and rugosity are not very good specific characters—the present collection of *Celtis willistoni* emphasizes this, and it is also illustrated among the stones of our existing North American species, but inasmuch as *Celtis phenacodorum* and *Celtis hatcheri* are found at different geological horizons and in different regions I do not feel justified in asserting their specific identity.

Figures 1 to 6

DESCRIPTIONS.—Stones ranging from nearly spherical to prolate, usually evenly rounded proximad, slightly narrowed and bluntly pointed distad where the lateral rugæ unite. Nearly circular in transverse profile, the diameter at right angles to the sutures slightly greater than the diameter parallel with the sutures in the larger and more normal sized stones. As might be expected, the smaller stones show just the reverse dimensions—the diameter parallel to the sutures is slightly more than that

at right angles to the sutures, and this leads me to think that the relatively rare smaller stones are puny, and that the larger represent the normal size for the species. These dimensions come out in the following measurements, which are given in millimeters:

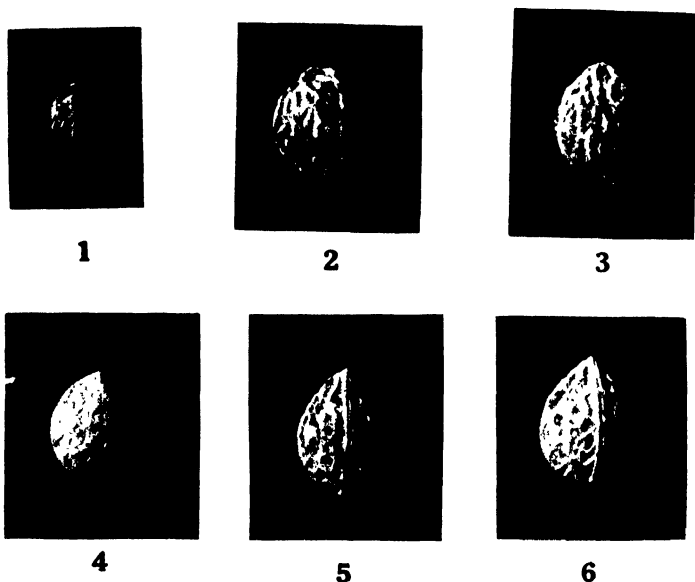


Fig. 1. Side view of minimum sized specimen from Kit Carson County, Colorado. Three times natural size.

Fig. 2. Side view of larger specimen from same locality. Three times natural size.

Fig. 3. Side view of a normal sized specimen from Phillips County, Kansas. Three times natural size.

Fig. 4. Sutural view of smooth form from same locality. Three times natural size.

Fig. 5 and Fig. 6. Sutural views of normal rugose forms from the same locality. Three times natural size.

Length.	Diameter, right angles to sutures.	Diameter, parallel with sutures.
3.25	3.00	3.10
4.00	3.25	4.00
3.75	3.25	3.50
6.50	5.00	4.60
6.00	4.50	5.00
6.00	4.50	4.50
6.70	5.00	4.50

The average length of the stones is about 6 millimeters and the length is more constant than the diameters.

The surface ornamentation is of the same type throughout all of the material, but varies considerably in intensity. It is not possible to determine to what an extent this variation is natural and to what degree it is artificial. Celtis stones of a single existing species show considerable variation with respect to this feature. I doubt very much if the fossils suffered any considerable wear before entombment, although they may have suffered some, as the matrix is an illy sorted and rather coarse sharp sand. That they have been abraded somewhat in the more than 40 years since they were collected is shown by the fact that of 171 loose specimens which I found in a bottle in the National Museum collections, the bottle contained a considerable amount of fine white dust due to attrition. How long they had been bottled or how much handling the bottle had undergone I do not know, but it was presumably not much.

The surface features of the highly ornamented stones, which outnumber the smooth stones five to one, may be described as follows: From the slightly umbonate or bluntly pointed apex a pair of opposite and relatively prominent keels or ridges extend downward to the base, becoming less prominent proximad. These are distinctly double with a suture between them all around and forming a complete circle, and evidently marking an abeiss line along which the stones sometimes separate into two equal halves. There may or there may not be a pair of less prominent and less complete ribs between the sutural ridges. The remainder of the surface is covered with more or less conspicuous reticulating ridges or rugae subtending irregular polygonal depressions. The surface, under a magnification of 41 diameters, appears compact, and shows no indication of the outlines of the stone cells of which it is composed. The wall is 0.5 millimeter in thickness.

In all of the foregoing features these fossils agree with the modern stones of Celtis. They differ from any Euphorbia seeds that I have seen in their larger size, in the absence of any trace of the raphe which is so prominent a feature in that group, in the presence of a sutural ridge around the whole circumference, and in the rugose surface—the last corresponding to what is met with in Celtis, and unlike that in any Euphorbia seeds studied.

It was the superficial resemblance of these fossils to the seeds of the common western *Euphorbia* or *Tithymalus marginata* that led to Williston's suggestion of the relationship for the fossils which was adopted by Cockerell. In the seeds of this species the raphe is conspicuous from the chalaza to the hilum—a characteristic of anatropous seeds—and there is no apparent reason why it should fail to become silicified along with the

rest of the seed coat. If it were conceivable that the raphe failed of preservation its position would surely be indicated by the configuration of the ventral face of the seed as compared with the dorsal face, because there is a smooth band along the raphe which is bordered on either side by a row of relatively prominent tubercles. The fossils are so numerous and so well preserved that it would certainly be possible to detect differences in ornamentation of the two surfaces if such had been present in life. Moreover the ornamentation in *Euphorbia marginata* is distinctly not of the rugose type which the fossils show, but is tuberculate or papillose, and not pitted.

The lateral meridians of the *Euphorbia* seed 90° from the raphe on each side, show a row of prominent tubercles which coalesce upward to form a prominent keel of which the chalazal apex is the center. Under the microscope (41 diameters) the stone cells of the seed coat are readily seen to be from three to five times as long as wide and oriented with their long axes parallel with the long axis of the seed, whereas a similar magnification of the fossil or Recent *Celtis* stones shows a compact surface with no trace of the outlines of the constituent and much smaller cells.

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ODORS AND INSECTS

BY F. W. BROWN

The following experiments were made at the suggestion of Dr. Frank E. Lutz during the month that I was a guest of the American Museum's Station for the Study of Insects near Tuxedo, N. Y. While not as complete as might be desired, they yielded apparently definite results so far as they went.

ODORS ATTRACTING ADULT *Drosophila melanogaster*

This "Pomace Fly" has become a standard laboratory insect. Twenty years ago Barrows (1907, *Journal Exp. Zoology*, IV, p. 515) reported on its reactions to odorous substances, particularly those chemicals that are found in fermenting bananas. More recently (See, for examples, Northrop, 1917, *Journal Biol. Chemistry*, XXX, p. 181, and Baumberger, 1919, *Journal Exp. Zoology*, XXVIII, p. 1) it has been found that *Drosophila melanogaster* larvae feed on yeast rather than on the substratum (banana or the so-called "inorganic foods"). The fact that yeast, quite apart from its products, is a sufficient food for these larvae was confirmed by Dr. Lutz at the Station this summer when he reared a large number of the flies on Fleischmann's yeast that was continuously washed in a filter with running water.

Last year Mr. Steele, also working at the American Museum's entomological field station, found that carrion beetles were attracted by the odor of larvae feeding upon carrion rather than by the odor of the carrion itself; likewise, that they eat the maggots rather than the "substratum" of the maggots, the carrion. The analogy of this case to that of the pomace fly is practically complete.

EXPERIMENT 1. Apparatus: A wooden box $10 \times 15 \times 3\frac{1}{2}$ inches having a glass cover luted for tightness, fitted with an opening on each side for inlet and outlet. For this trial one opening in a 10-inch wall was used as a suction, the remaining three openings were each fitted with a piece of $\frac{3}{16}$ inch glass tubing used to introduce the odors. One tube supplied the odor from fermenting banana, another moist air, and through

the third tube air was drawn through a piece of cotton moistened with water, the cotton previously having been treated with a purified benzine extract of fermenting banana, and solvent evaporated. The odor imparted to the cotton was decidedly yeasty.

Suction was begun at the rate of approximately 500 cu. in. of air per hour during the first 30 minutes of the test. Through this period 10 flies entered the tube containing the banana pulp, none entering the tube which supplied the moist air or that through which the benzine extract residue was being aspirated. This benzine residue was then changed to a 50% alcoholic extraction of the benzine containing the extracts of the banana, and solvent evaporated. Suction was again begun at the same rate and at the expiration of 30 minutes there were 11 flies in the tube of the banana pulp, the tube containing the residue of the alcoholic washing of the benzine extract on the moistened cotton had not been visited. Suction was continued for 1½ hours during which time 3 flies visited the tube containing the extract residue. This experiment was then discontinued.

EXPERIMENT 2.—25 grams of soft banana, representing a cross-section including the peel, were extracted with 100 cc. of methanol (purified), the extract filtered and then evaporated to 10 grams. The approximate alcoholic strength of the strength of extract as filtered was 83%. Evaporation was carried on at a temperature under the boiling point of the liquid. The odor of the residual 10 grams was slightly acetic, mild, banana-like.

Three test tubes were prepared, one containing fermenting banana, the second a small plug of cotton moistened with water, the third tube containing the 10 grams of extract absorbed on cotton. The three tubes were placed in an observation box having 3 sides of fine mesh screening and 1 of glass. The one end was of wood, the other of glass.

A number of flies were introduced direct from the stock jar. Results of the visits are tabulated below:

TIME	WATER	BANANA	BANANA EXTRACT
1:55	0	0	2
2:00	0	1	6
2:05	1	7	1
2:15	1	10	2
2:30	0	3	2
	—	—	—
	2	21	13

The flies showing no strong desire to feed, the banana and the banana extract were removed for 26 hours. When replaced, with an empty tube added to the equipment, the results were:

TIME	WATER	BANANA	BANANA EXTRACT	EMPTY TUBE
4:30	0	8	4	0
4:35	0	4	2	0
4:40	0	15	3	0
4:50	0	25	2	0
5:10	0	24	1	0
	—	—	—	—
	0	76	12	0

The results of these experiments indicate that the fermenting banana has greater attractiveness than the extract. The checks were blank.

Since fermenting banana possesses more attraction than fresh fruit and since yeast is the fermenting agent, possibly alcohol is the attractant (See also the paper by Barrows). With this in mind a mixture of glucose $1\frac{1}{2}$ grams, molasses $2\frac{1}{2}$ grams, sulphate of magnesia $\frac{1}{10}$ gram, phosphate of magnesia $\frac{1}{10}$ gram, citric acid $\frac{2}{10}$ gram and water 100 cc. was inoculated by a stab into a soft banana and a stab at the broken section of the skin for cultural material.

While this was fermenting a box was prepared 16 inches square provided with a glass cover, the inner part of the box being divided into four triangular compartments, the partitions ending about $1\frac{1}{2}$ inches from the center, leaving a three-inch gap. Each compartment was ventilated by providing a screen window $2\frac{1}{2} \times 8$ inches, to permit a free flow of air currents. Three of the compartments were provided with Petri dishes. On one was soft banana, on one was a banana extract containing 5% of ethyl alcohol absorbed on cotton, and the third one was provided with the fermenting glucose and molasses mixture absorbed on cotton which had been permitted to stand at room temperature for 48 hours.

A number of flies were taken direct from the stock bottle and introduced into the vacant chamber. After 30 minutes of observation no feeding was observed although several flies visited the banana and the fermenting fluid, but none showed an inclination to eat. The glass cover was lifted to free the box of flies and then replaced. The Petri dishes were left in place for twenty-four hours, after which time a fresh batch of flies that had been kept without food for twelve hours was introduced and the following results observed:

BANANA	BANANA EXTRACT	FERMENTING FLUID
23	2	28

The flies were disturbed and the apparatus turned halfway around, and after an elapse of one hour they were again observed:

18	3	22
----	---	----

Observation half an hour later showed:

25	0	21
----	---	----

The cotton containing the banana extract, also the cotton containing the fermenting fluid was moistened with more of the fluid material, and after an elapse of twelve hours further observations were made:

Over 100	0	14
----------	---	----

The materials were examined for eggs. Both of the prepared foods were apparently free from eggs while the banana showed deposits of eggs in several places. These were not counted.

This experiment was repeated with freshly prepared baits, banana extract being omitted, the fermenting fluid this time being glucose diluted with water containing magnesia sulphate and phosphate, inoculated with a stab of fermenting banana, and possessing a mildly vinous odor. The visits were as follows:

BANANA	WATER	FERMENTING FLUID
2	0	7
4	0	6
4	0	6
5	0	8
8	0	10
2	0	5
—	—	—
25	0	32

The results indicating that either yeast or the products of fermentation possessed an attraction for the flies. Another experiment was carried on with fermenting soft banana, and a commercial yeast cake mixed with sufficient water to bring it to a stiff creamy consistency. These were placed in two compartments of the box, and into the third compartment was introduced a number of flies that had been kept without food for six hours. The following counts were made during the evening of July 20 and the morning of July 21:

YEAST	BANANA
7	9
6	9
6	15
10	15
3	15
<u>23</u>	<u>63</u>

On the morning of the 21st both the yeast and the banana were examined for eggs. On the yeast were found 9 eggs and 6 larvæ. On the banana 50 eggs and 40 larvæ.

These figures led us to attempt further trials, but with yeast culture from banana.

The box was prepared with 3 Petri dishes, 1 containing a piece of banana, the second moistened with a fluid composed of starch 6 grams, hydrochloric acid 2 grams, water 120 grams, boiled until clarified, then 1 gram of sulphate of magnesia, 1 gram of phosphate of magnesia and 1 gram of citric acid added after neutralizing the hydrochloric acid with ammonia. This solution when tested with Benedict solution showed no sugar and was fermenting for 11 days before being used. The third was fermenting Karo solution made by dissolving 20 grams of Karo syrup, 2 grams magnesium sulphate, 2 grams of potassium phosphate, 2 grams citric acid and 380 cc. of water. This was also permitted to stand for 10 days before being used. The odor of the fermenting starch was decidedly yeast-like. The odor of the fermenting Karo was vinous and the banana was typical.

A number of flies were introduced into the vacant compartment and the following results noted:

BANANA	STARCH	KARO
6	0	7
3	1	7
3	1	4
3	3	8
3	3	7
7	9	4
7	11	4
5	11	5
7	8	5
7	11	4
6	7	9
5	7	4
7	9	7
<u>5</u>	<u>11</u>	<u>8</u>
67	92	83

After 24 hours the contents of the dishes were examined for eggs. Eggs were observed on the banana and on the Karo fermentation product, while the starch showed none.

This experiment then led us to try the fermenting liquid as compared to yeast. The fermenting product of Karo was filtered and the yeast content on the filter paper was washed with water during 12 hours to completely eliminate all soluble matter. This filter paper containing the washed yeast was opened on the Petri dish, the filtrate was refiltered and a part absorbed on cotton. The filtrate possessed a vinous odor modified by a very slight yeast-like character. The material on the filter paper possessed a strong yeast odor.

A number of flies were liberated in the vacant chamber and the following count made:

TIME	FILTERED LIQUID	YEAST
10:40	2	11
10:55	1	18
11:10	0	22
11:25	0	22

The position of the Petri dishes was then reversed and observations again made:

TIME	FILTERED LIQUID	YEAST
11:45	0	25
12:	0	29

A test was made in a T tube, one arm provided with a plug of cotton containing yeast, the other arm a plug of cotton containing fermenting liquid. The stem was passed through a cork into a test tube containing a number of flies. Suction was applied to the test tube drawing the air through the prepared cotton plugs. The arm of the tube containing the yeast received 56 visits while that containing the fermenting fluid received 57 visits from flies.

Adult *Drosophila melanogaster* are clearly attracted by the odor of the yeast upon which their larvæ feed but this reflex appears to be at least somewhat "conditioned" by the odors usually associated with that yeast.

TRAINING BEES TO ODOR

This experiment, based on the interesting work of Karl v. Frisch, was undertaken to analyze more completely the olfactory factors in flowers which are noted by the common honey-bee, *Apis*.

Upon a table-like surface 12 Petri dishes were each fitted with a 4-inch circle of filter paper upon which rested a watch glass. Four of the filter papers possessed no odor other than that of paper. The remaining eight were impregnated with a solution of paraffin and purified benzine to which was added an odor. 1% of the following odor bodies was used:

Anethol
Carvone
Citral
Synthetic oil of Lily of the Valley

The other four were scented with extracts of the following blooms:

Daisy
New Jersey Tea
Yarrow
Milk-weed

Eight grams of the bloom were extracted with sufficient purified benzine to make 50 cc. of extract. Into this was dissolved 3 grams of paraffin. The extracts expressed the odors of the respective flowers to a marked degree, and as yarrow presented no particular attractiveness to the bees it was decided to use this extracted odor to train the bee, which was done by putting into the watch glass, imposed upon the filter paper impregnated with the yarrow extract, some sugar and water and maintaining this supply continuously during the working hours of the bee. Each time the water or sugar in the watch glass was replenished the position of this unit on the board was changed.

During the first afternoon the bees hovered over the various dishes ultimately finding the sugar. The same conduct continued during the next morning, Friday, July 21st. During the afternoon of the 21st less time was spent in searching for the sugar dish. The bees apparently had begun to associate the odor of the yarrow with the sugar. The papers containing the extract were changed daily, this being done to maintain pungency.

On Sunday, July 24, 10 bees were marked for identification and at P.M. a new Petri dish and watch glass without sugar were provided with a freshly prepared disk of filter paper impregnated with the yarrow

extract. This unit replaced the yarrow unit that was used to support the watch glass containing the sugar. The position of the dish on the test board was changed and a count of the bees going to the board was taken:

Yarrow	43
Anethol	0
Citral	1
Daisy	1
Blank	1
Blank	1
N. J. Tea	0
Milk weed	0
Blank	0
Blank	0
Lily of Valley	0

The bees were driven from the units and the same rearranged when a 10 minute count was again made:

Yarrow	29
Anethol	0
Citral	12
Daisy	0
Blank	0
Blank	0
N. J. Tea	0
Milk weed	0
Blank	0
Carvone	1
Blank	2
Lily of Valley	0

Sugar water was again supplied to the yarrow unit and feeding continued during the preparation of a new agent, which was done as follows: 15 cc. of yarrow benzine extract was extracted with 10 cc. of 80% methanol, the alcoholic extract separated and evaporated on a disk of filter paper. The benzine residue was also evaporated on a disk of filter paper, and on July 26 the location of the feeding disk was again changed every 5 minutes for 20 changes, then the sugar water and yarrow unit was removed with 1 blank and two units containing respectively the benzine residue and alcoholic extraction evaporated on filter papers were substituted with a shift of positions. A count was taken during a period of 10 minutes with the following results: The alcoholic extract showed 46 visits; the benzine residue 4 visits; blanks 11 visits.

The alcoholic washing of the benzine extract was colorless and possessed the odor of the bloom to a marked degree, which diffused more rapidly than the benzine extraction, undoubtedly due to the absence of paraffin. The benzine residue from the alcoholic extraction contained the color and whatever wax and fixed oils that had been extracted from the flowers by the benzine, the odor having been yielded to the alcohol.

Unfortunately, it was necessary for me to leave the work at this point, but it is clear that the bees' mental association of sugar with extracted odors of yarrow concerns chiefly that substance or those substances which are removed from the benzine extract by alcohol.

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CARPENTER BEES OF THE GENUS *MESOTRICHIA* OBTAINED BY THE AMERICAN MUSEUM CONGO EXPEDITION, 1909-1915¹

BY NORMA LEVEQUE

The females of almost all the species of *Mesotrichia* bear a pouch of chamber in the first abdominal segment. The only opening to this chamber is on the anterior face of this first segment, just dorsal to the point of attachment of the abdomen and thorax. Thus when the abdomen is appressed against the thorax this small oval-rimmed hole is faced by the metathorax. In this pouch may be found mites of the genus *Paragreenia* Cockerell, 1907, (Syn. *Greenia* Oudemans, 1901, pre-occupied; *Dolaea* Oudemans, 1912; *Greeniella* Banks, pre-occupied) of the Parasitidæ of Order Acarina. The different species of *Paragreenia* vary in length from 1 mm. to a little over 3 mm. Other mites, especially of the genus *Trichotarsus*, very minute animals, have occasionally been found in the pouch.

Interest in the symbiotic relationship between the *Paragreenia* and these carpenter bees led me to make this survey of the collection of *Mesotrichia* obtained by the American Museum Congo Expedition, of which expedition Mr. H. Lang and Mr. J. P. Chapin were leaders. From June 1909 to October 1915 they explored the Congo Basin from the mouth to the borders of Anglo-Egyptian Sudan. About eight hundred *Mesotrichia* were obtained, among which there are twenty-two species, eight of which are new. An assortment of these specimens is to be sent to the Belgium Museum; the others are retained by The American Museum of Natural History. All type specimens will be with the American Museum.

Dr. T. D. A. Cockerell of the University of Colorado has given very valuable assistance in determining the *Mesotrichia* and also in observations noted in the description of the new species found. Mr. S. A. Rohwer of the Bureau of Entomology, U. S. Department of Agriculture, Washington, has kindly assisted with comparisons.

¹Scientific Results of the American Museum Congo Expedition. Entomology, No. 17.

All the figures of genitalia belonging to this group of bees from Africa given by Maidl in 'Die Xylocopen (Holzbienen) des Wiener Hofmuseums,' 1912, have been traced and are shown by Figs. 17 to 29. The legend for Fig. 22 has been corrected by me from *luteola* Vachal to *luteola* Lepeletier. Just what Maidl has determined as *olivacea* Smith is perplexing (Fig. 18). *M. olivacea* Smith is a synonym of *luteola* Lepeletier; *olivacea* Fabricius is a synonym of *caffra* Linnæus. Figure 18 most closely approximates Fig. 14 of *stanleyi*, new species, except for absence of the dense cluster of hairs on inner ventral curve of the stipites. Genitalia of the different species obtained on this expedition, which have been permanently mounted in balsam, are herein figured. These latter figures have been drawn with the aid of the camera lucida by myself.

From the various authors listed in the bibliography, especially from Friese, 1909, and from subsequent reports, I have compiled the following list of species of *Mesotrichia* in Africa and have added the new species. All species were originally described as *Xylocopa* or as subgenus *Mesotrichia* or *Koptorthosoma*, except those by T. D. A. Cockerell and myself.

- M. absurdipes* Enderlein, 1903, Hopefield, West Cape Colony.
- M. arsuans* Linnaeus, 1758, Egypt; Senegal.
- M. arsuans rubicula* Gribodo, 1884, Ambo-Rarra.
- M. africana* Fabricius, 1781, Guinea.
- M. africana conradti* Enderlein, 1903, Bismarckburg, Togo.
- M. africana congouensis* Enderlein, 1903, Ogowe, Congo.
- M. africana longjinensis* Strand, 1911, Cameroons.
- M. albiceps* Fabricius, 1804, Guinea.
- M. albifimbria* Vachal, 1898, San-Benito (Maidl says = *præusta* Sm.).
- M. apicalis* Smith, 1854, Sierra Leone; Gambia.
- M. berisi* Cockerell, 1917, Umbilo, Natal.
- M. caffra* Linnaeus, 1767, Africa.
- M. caffra mossambica* Gribodo, 1894, Magnarra, Mozambique.
- M. caffra nigrescens* Maidl, 1912, Cape of Good Hope, Algoa Bay.
- M. caffraria* Enderlein, 1903, Kaffraria, Cape Colony.
- M. caffraria capensis* Enderlein, 1903; Cape Colony.
- M. calcarata*, new species, Garamba, Congo.
- M. calens* Lepeletier, 1841, Madagascar.
- M. calens atripyga* Strand, 1911, Usambara, German East Africa.
- M. calens malagassa* Saussure, 1891, (described as variety of *M. olivacea*).
- M. chapini*, new species, Faradje, Congo.
- M. citrina*, Friese, 1909, Togo; Congo.
- M. cloti* Vachal, 1898, Upper Egypt; Natal; West Africa.

- M. codinai* Dusmet, 1924, Cameroons.
M. combusta Smith, 1854, Congo; Sierra Leone, Angola, Fernando Po.
M. divisa Klug, 1807, (Friese reports from Abyssinia, Natal, Mozambique).
M. duala Strand, 1921, Cameroons.
M. erlangeri Enderlein, 1903, Bornu; Somali.
M. escaleraei Dusmet, 1924, Fernando Po.
M. eximia Friese, 1908, Ikutha, British East Africa.
M. flavobicincta Gribodo, 1894, Benue (West Africa).
M. flavobicincta uluguruna Enderlein, 1903, German East Africa.
M. flavorufa DeGeer, 1841, Kaffraria, Cape Colony.
M. flavorufa kristenseni Friese, 1911, Abyssinia.
M. forsiusi Dusmet, 1924, Abyssinia.
M. fulva Friese, 1922, Cameroons.
M. gabonica Gribodo, 1894, Gabun; Congo; Sierra Leone.
M. ignescens, new species, Banana, Congo.
M. imitator Smith, 1854, Sierra Leone; Congo; Gold Coast.
M. imitator nigriceps Friese, 1922, Sierra Leone.
M. insola Vachal, 1910, Belgian Congo.
M. incerta Perez, 1901.
M. incerta seychellensis Cockerell, 1912, Seychelles.
M. langi, new species, Faradje, Congo.
M. lateritia Klug, 1854, Isle of Johanna, Mozambique.
M. lepeletieri Enderlein, 1903, Guinea; West Africa; South Cameroons.
M. lepeletieri ruboris Strand, 1920, Leopoldville, Congo.
M. leucothoracoides Maidl, 1912, Dar es Salam.
M. leucothorax DeGeer, 1773, Egypt.
M. luteola Lepeletier, 1841, Nubia.
M. media Vachal, 1909, Lumbwa.
M. mixta Radoszkowski, 1881, Angola.
M. modesta Smith, 1854, Gambia.
M. modesta denasta Strand, 1911, Liberia; Togo.
M. modesta miniata Friese, 1921, Belgian Congo.
M. nigricans Vachal, 1910, Belgian Congo.
M. nigricaula, new species, Garamba, Congo.
M. nigriceps Friese, 1922, Dibongo, South Cameroons.
M. nigripes Friese, 1915, Southeast Abyssinia.
M. nigrita Fabricius, 1775, Sierra Leone.
M. nyassica Enderlein, 1903, German East Africa.
M. obscurata Smith, 1854, West Africa.
M. olivacea Fabricius = syn. of *M. caffra* Linnaeus.
M. orthosiphonis Cockerell, 1908, Benguela.
M. perpunctata, new species, Boma, Congo.
M. praeusta Smith, 1854, Congo.
M. preussi Enderlein, 1903, Cameroons; Togo.
M. pseudoleucothorax Maidl, 1912, Dar es Salam.
M. rufosellata Cockerell, 1922, Maritzburg, Natal.

- M. schoana* Enderlein, 1903, Shoa, Abyssinia.
M. scioensis Gribodo, 1884, Ambo-Karra.
M. senex Friese, 1922, Lake Tanganyika; Tamatave, Madagascar.
M. senior Vachal, 1899, German East Africa.
M. senior albopleuralis Friese, 1922, Ikutha, British East Africa.
M. senior chitelligera Friese, 1922, German East Africa.
M. stanleyi, new species, Stanleyville, Congo.
M. stuhlmanni Kohl, 1893, German East Africa.
M. stuhlmanni albicincta Enderlein, 1903, German East Africa.
M. stuhlmanni alticola Cockerell, 1919, Mt. Kilimanjaro.
M. subcombusta, new species, Banana, Congo.
M. suspiciosa Vachal, 1899, Delagoa Bay.
M. togonensis Enderlein, 1903, Togo.
M. torrida Westwood, 1838, Fernando Po; Angola.
M. torrida gramineipennis Friese, 1922, Gold Coast.
M. varipes Smith, 1854, Sierra Leone; Fernando Po; Gabun; Cameroons.
M. varipes melanotrichia Strand, 1914, Cameroons.
M. varipes parva Enderlein, 1903, North Cameroons.

Two species formerly considered to be of the *Mesotrichia* group are placed in *Xylocopa*, for the reasons stated on page 21:

- Xylocopa inconstans* Smith, 1874, South Africa.
X. chiyakenis (Cockerell), 1908, Benguela, West Africa.

The following list includes all localities at which *Mesotrichia* was collected.

SOUTH OF EQUATORIAL RAIN FOREST

- Banana, 6° S., 12° 20' E.
 Malela, 6° S., 12° 40' E.
 Zambi, 6° S., 12° 50' E.
 Matadi, 5° 50' S., 13° 35' E.
 Boma, 5° 50' S., 13° 10' E.
 Thysville, 5° 30' S., 15° E.
 Leopoldville, 4° 25' S., 15° 20' E.
 Kinsbasa, 4° 20' S., 15° 20' E.
 Kwamouth, 3° 20' S., 16° 10' E.

IN THE RAIN FOREST

- Coquilhatville, 0° 1' N., 18° 20' E.
 Lisala, 2° 10' N., 21° 30' E.

IN THE RAIN FOREST—(continued)

- Stanleyville, 0° 30' N., 25° 15' E.
 Batama, 1° N., 26° 40' E.
 Bafwasende, 1° 10' N., 27° E.
 Avakubi, 1° 20' N., 27° 40' E.
 Gamangui, 2° 10' N., 27° 20' E.
 Medje, 2° 25' N., 27° 30' E.

NORTH OF THE EQUATORIAL RAIN FOREST

- Poko, 3° 10' N., 26° 50' E.
 Niangara, 3° 40' N., 27° 50' E.
 Vankerekhovenville, 3° 20' N., 29° 20' E.
 Faradje, 3° 40' N., 29° 40' E.
 Garamba, 4° 10' N., 29° 40' E.

Mesotrichia chapini, new species

Both male and female specimens, upon first examination, agree rather closely with Lepeletier's description (1841) of *flavorufa* DeGeer, except for color of wings and red pubescence on abdomen. The male genitalia are found to differ from Maidl's figure of the *flavorufa* genitalia, Fig. 27. Lepeletier describes the female of *flavorufa* as: "alae nigrae, basi late violaceo, apice aeneo nitentes," whereas *chapini* has a dark blue, green and a touch of purple iridescence, with the same color-tone throughout the wings. Moreover the hind margin of segment five and the terminal segment of the abdomen are described as having ferruginous pubescence, whereas only the terminal segment of *chapini* has the red color. On the other hand, *chapini* has some red hair on the occiput not described by Lepeletier but mentioned by Vachal (1899). The *flavorufa* determined by Vachal were females from Delagoa Bay, Zambezi and Tanga, all East Coast Africa. Lepeletier's specimen was from Kaffraria. Gribodo, 1895, records specimens from Mosambique which have a less reddish color, but rather a brown color, and have a bald area on the mesonotum where the hairs may have been rubbed off.

MALE.—Type from Faradje, December 1912. Large robust bee with large light eyes, narrow face with light clypeus and supra-clypeal area, former with some short brown hairs. Body shiny black, with red-brown hairs on prothorax, pleurae, and on last abdominal segment. Wings dark with blue, green and purple iridescence.

Head.—Black except clypeus, supra-clypeal area, two minute spots below anterior ocellus sometimes evanescent, usually small spot on base of each mandible, triangular process on labrum with evanescent median spot or two lateral spots on labrum, under side of scape, which are light; second and last segments of antennae are reddish; underside of flagellum, except first joint, is testaceous. Thick covering of dark red-brown hair, except on supra-clypeal area and usually lower margin and medial line of clypeus. Golden-brown hairs on labrum and on groove of mandibles. Supra-clypeal area slightly punctured. Eyes light, large, very slightly converging, 2 mm. apart at vertex. Third antennal joint about equal to length of three following.

Thorax.—11 mm. wide; 9 mm. long; black, bald, shiny disk surrounded by thick covering of golden-brown hairs extending over pleurae, and more sparsely over scutellum. Hairs on sternum dark brown. Tegulae dark red-brown, shining, with short nap of golden hairs at base and extending slightly on anterior margin of upper wings.

Abdomen.—12 mm. wide, about 16 mm. long; black, shining, sparsely punctured, black hairs on sides, and on last segment, longer near posterior segments; few golden-brown hairs mingling on margin of sixth segment, and on anal segment.

Legs.—Brownish black, except: femora I, all last tarsal segments, bases of claw, and distal spot on basitarsi II, which are red-brown; hairs mostly dark brown, except red-brown on tarsi I, golden brown on outer side of tibiae I and anterior margin of tibiae, and brighter and longer on tarsi II; posterior fringe of tarsi II is dark brown, with pointed brush-like growth at distal margin of first three tarsal segments, latter fringe

slightly mixed with light hairs. Femora II laterally compressed, with tubercle near center of ventral margin, giving a triangular shape. Femora I practically bare.

Wings.—Dark, shiny with blue, some green, and purple iridescence, 27 mm. long.

Genitalia.—Fig. 1.

FEMALE.—Allotype from Faradje, November 1912. A large robust black bee with russet-brown hairs on thorax and pleurae; bald shiny disk on thorax; wings dark, with green, blue and purple iridescence; abdomen rather elongate, fringed on sides with short tufts of black hair; last segment also has an anal fringe of shorter russet-red hairs.

Head.—8 mm. wide; black, coarsely, fairly closely, though unevenly, punctured, sparingly covered with brownish-black hairs, thicker below antennae, on lower half of clypeus, and on lower cheeks, where longer; russet-red hairs over labrum and in groove on mandibles. Edge of occiput with few short russet-brown hairs. Mandibles toothed, sparingly punctured near base. Maxillae heavy, shiny, 4.5 mm. long. Clypeus closely and rather coarsely punctured, surrounded by an emarginate, slightly raised, shiny line. Supra-clypeal area punctured, slightly raised, and bearing a cleft ridge terminating at anterior ocellus. Area above compound eyes more sparingly punctured. Antennae black, second segment reddish, flagellum testaceous beneath; third segment almost as long as three following segments.

Thorax.—7 mm. long; 10 mm. wide; black with bald shiny disk usually extending to rim of scutellum, surrounded by thick covering of short dark ferruginous hairs extending on to pleurae. Where hairs have been rubbed off puncturing is seen to be close and coarse, especially near anterior and lateral margins of thorax. Sternum with some brownish-black hairs. Tegulae with bald disk; small tufting of some short russet-brown hairs on base of anterior wings.

Abdomen.—12 mm. wide; about 16 mm. long; black, shiny; sparingly punctured; practically bald except for black fringe on sides, which is somewhat tufted on last segments. Anal segment has lateral black tufts, margined at center with russet-red hairs shortest at center.

Legs.—Black, except base of claws reddish; hairs black, except some red-brown at distal end of posterior margin of tibiae I, and some more red on underside of basitarsi I; underside of tarsal segments 2 to 5 of all legs with short napping of reddish hairs.

Wings.—27 mm. Dark, shiny, with blue, some green and purple iridescence.

LOCALITIES.—All are from the Uele district, northeast of the Rain Forest belt: 24 males and 28 females from Faradje (one battered female has rosy, probably discolored wings); 1 male and 5 females from Garamba.

Mesotrichia ignescens, new species

Large robust bee similar to *chapini* but may be distinguished by: hairs of thorax darker; brown hairs confined to small area anterior to tegulae, to pleurae, and to a "necktie" tuft on sternum between anterior legs; brown hairs of anal segment shorter and confined to posterior margin on ventral side; wings more brilliant, with blue, green, and rosy-purple iridescence. For comparison of genitalia see Figs. 1 and 2.

MALE.—Type from Boma, June 17, 1915.

Head.—Black, except: clypeus, supra-clypeal area, two very small spots below anterior ocellus, and under side of scape, which are light; antennal segments following

first long segment of flagellum, testaceous beneath. Bare area of supra-clypeal area and clypeus shows very slight puncturing. Mandibles toothed and grooved. Hair dark, short and thick on face, easily rubbed off the clypeus; on vertex longer and mixed with a few lighter brown; on labrum and groove of mandibles a few short golden hairs. Eyes large, parallel, about 2.5 mm. apart.

Thorax.—Black; with bald, smooth central disk, slightly punctured around edge, surrounded with short nap of dark brown hairs with a region of golden-brown hair anterior to tegulae and extending to pleurae. Scutellum almost bare; slightly punctured. Width 11 mm.; length 9 mm.

Abdomen.—Black, shining, sparingly punctured, almost bare except for lateral fringe of black hair beginning on fourth segment, longest on last two segments. Venter shows some light brown hairs near median line and surrounding anal opening. Width 12 mm.

Legs.—Anterior, red-brown; others dark brown; last tarsal segments more reddish. Base of claws red; apex dark brown. Hair mostly dark brown; some golden brown on posterior margin of basal part of basitarsi I; shorter red-brown on anterior margin of same and on other tarsal segments of leg I. Tarsi II have a wide lateral fringe mixed with golden-brown or yellow-brown hairs. Femora II, covered with short, dark brown hairs, are compressed laterally and have a sharp tubercle on ventral margin, giving triangular shape from posterior view.

Wings.—Dark; shining; blue, green and violet iridescence. Length, 27 mm.

Genitalia.—Fig. 2.

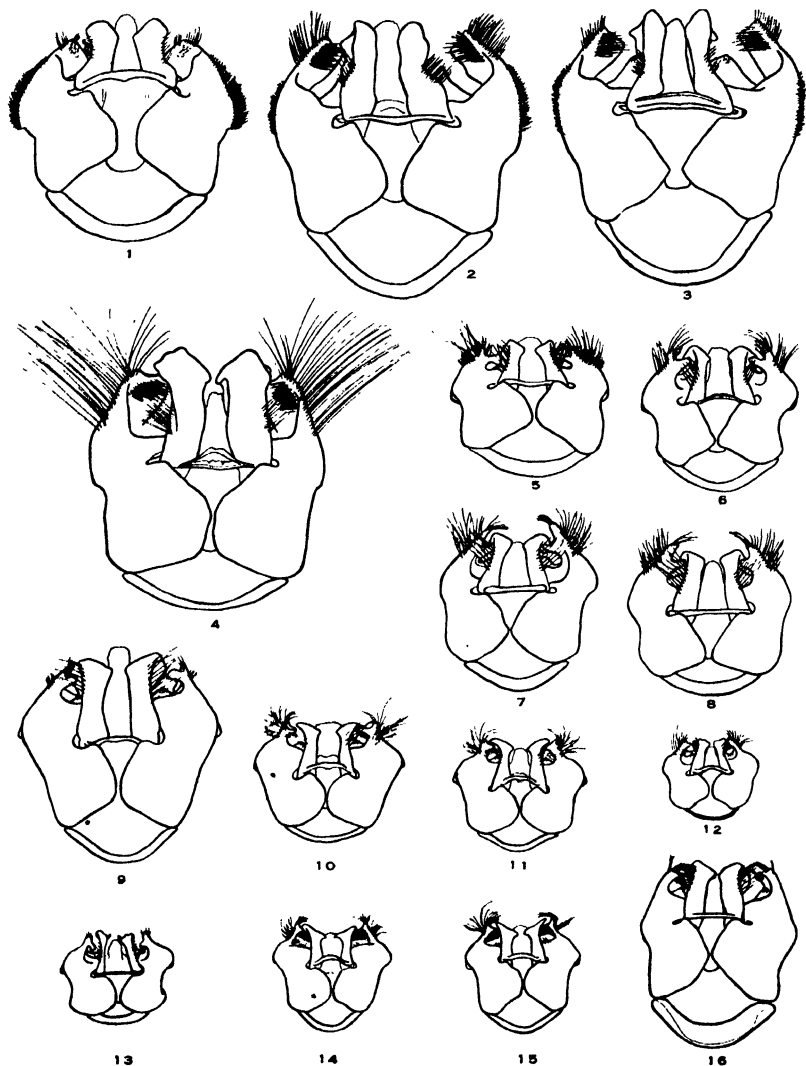
LOCALITIES. —One male (type) from Boma, June; another from Banana, July.

KEY TO SEPARATE FEMALES OF *M. combusta*, *subcombusta*, *torrida*, AND *perpunctata*

- 1.—Body broad (intertegular space 9 mm., abdomen 14-15 mm. broad), wings dark with shining blue and violet iridescence. 2.
 Body narrower (intertegular space 7-8 mm., abdomen 13 mm. broad), wings dark with green and copper iridescence predominating, some blue or violet. 3.
- 2.—Antennae dark, punctures on sides of abdominal segments fine and close together, few short red hairs in anal tuft rather unnoticeable. *M. perpunctata*.
 Scape mahogany, flagellum dark, slightly testaceous beneath, abdomen sparingly punctate *M. subcombusta*.
3. —Antennae dark, flagellum from segment 3 testaceous below, anal tuft black with tinge of red unnoticeable without lens, abdomen finely and closely punctured, especially at sides. *M. torrida*.
 Antennae reddish, dark testaceous below, anal tuft red, abdomen moderately punctate *M. combusta*.

Mesotrichia combusta (Smith)

Female specimens obtained from the Western Forest Province, south of the Equatorial Rain Forest, were compared with a specimen determined as *combusta* in the F. Smith collection, obtained from Angola, and now in T. D. A. Cockerell's collection. *M. combusta* is easily con-



Figs. 1 to 16. Genitalia of *Mesotrichia*: 1, *M. chapini*, new species, from Faradje; 2, *M. ignescens*, new species, from Banana; 3, *M. subcombusta*, new species, from Banana; 4, *M. torrida* Westwood, from Kwamouth; 5, *M. africana* Fabricius, from Banana; 6, *M. africana conradti* Enderlein, from Niangara; 7, *M. lepeletieri* Enderlein, from Stanleyville; 8, *M. lepeletieri ruboris* Strand, from Niangara; 9, *M. nigrita* Fabricius, from Stanleyville; 10, *M. luteola* Lepeletier, from Boma; 11, *M. luteola* Lepeletier, from Garamba; 12, *M. langi*, new species, from Faradje; 13, *M. nigri-caula*, new species, from Garamba; 14, *M. stanleyi*, new species, from Stanleyville; 15, *M. calcarata*, new species, from Garamba; 16, *Xylocopa chiyakensis* (Cockerell), from Garamba.

In order to determine the location of the plumose hairs, it would be well to examine these figures with a reading glass.

fused with *M. torrida* Westwood, *M. subcombusta*, new species, and *perpunctata*, new species. Vachal separates *M. torrida* and *M. combusta* on the punctures on the sides of the third abdominal segment. They are very fine and close together in the *torrida* female. *M. combusta* has an anal tuft of bright red hairs; *torrida* does not. The wings of *combusta* show deep fuscous and green iridescence, quite similar to the wing color of *torrida* and not having the rich blue iridescence of the wings of *subcombusta*.

Five females were obtained: 2 from Leopoldville, July; 2 from Kinshasa, May; and 1 from Kwamouth, July. Friese reports specimens from Congo, Sierra Leone, Angola, Fernando Po. Muidl reports specimens of *combusta* in 1912 from West Africa, Congo, Banana, Angola.

Mesotrichia subcombusta, new species

Large robust bee similar to *combusta* Smith, but abdomen of female is not so elongate, and iridescence of wings shows more blue. Hair of body shows a very dark brown cast almost a black, while hair of *combusta* is black.

FEMALE.—Type from Banana, August 1915.

Head.—Black; first three segments of antennae mahogany-red; following segments testaceous beneath; third segment about as long as the three following. Integument densely and coarsely punctured except shiny margin of clypeus and irregular shiny ridge extending from bases of mandibles over base of supra-clypeal area, median clypeal line, shining malar space; few shallow punctures on bases of mandibles, which otherwise are smooth and shining. A slightly cleft medial ridge divides around anterior ocellus. Short black hair more dense on face and occiput; few golden-brown hairs on labrum and in grooves of mandibles. Width between eyes 5 mm. Mandibles toothed.

Thorax.—Black, dense covering of short black hairs over pronotum, around tegulae and on pleurae, leaving a bare, smooth, shiny central disk; scutellum slightly punctured. Width 12 mm. Length 8.5 mm.

Abdomen.—Black; sparingly punctured; almost bare; lateral black fringe, somewhat longer on last segment; anal tuft of some short golden-brown hairs. Length 13 mm.

Legs.—Black or very dark brown; claw segments and bases of claws red-brown.

Wings.—Dark, shining, with blue, green and violet iridescence.

Length.—26 mm.

MALE.—Type from Banana, August 1915. Very similar to female.

Head.—Black, except; scape in front, clypeus, supra-clypeal area, two spots on labrum which are light; flagellum, except first two segments, red-brown beneath. Thick covering of brownish-black hair. Eyes very large, parallel; 2.5 mm. apart.

Thorax.—Robust; central smooth shiny disk surrounded by slightly punctured area; dark brown hair over pronotum, around tegulae, and on pleurae; dark "necktie" tuft of hair on sternum between first legs; scutellum sparingly and finely punctured at center, more closely at sides. Width 12 mm. Length 9 mm.

Abdomen.—Black, shiny; more closely punctured on sides, but sparingly down center; almost bare; lateral fringe of black hair, longer and tufted on last three segments. Width 12 mm.

Legs.—Dark brown or black; femora I dark red-brown; last two tarsal segments, bases of claws of leg I, yellow-brown; claw segments and base of claws of other legs dark red-brown. Hair dark brown; dark red-brown on basitarsi I and II; mixture of dark brown, golden brown and red-brown forming a fringe on sides of all tarsal segments of leg II.

Wings.—Dark, blue and violet iridescence, greenish near base. Length 27 mm.

Genitalia.—Fig. 3. For comparison with *M. combusta* Smith, see Fig. 29.

LOCALITIES.—12 females and 5 males from Banana; 6 females and 2 males from Boma; 4 females from Malela and 5 from Zambi.

***Mesotrichia perpunctata*, new species**

Large robust black bee very similar to *M. subcombusta*, *M. combusta*, and *M. torrida*. See foregoing key for separation.

FEMALE.—Type from Boma, June 16, 1915.

Black; dark mahogany cast to apical half of last tarsal segments and base of claws, and flagellum below. Hair black or very dark brown, sparse on head, absent or well worn off on superior orbits; thicker on thorax, except on bald shining central disk; abdomen almost bare, except lateral and anal fringe; a few short red hairs mixed in anal tuft. Punctures on head close together except more scattered on superior orbits, a few shallow punctures on mandibles; no puncturing on irregular margin of clypeus, base of supra-clypeal area, and malar space. Thorax moderately punctured, except bare on shining central disk; abdomen sparingly punctured through medial area, quite densely so laterally. Wings dark with blue, purple, and some green iridescence; length 27 mm. Greatest diameter between eyes $5\frac{1}{2}$ mm. Length of body 29 mm.

LOCALITIES.—One female from Boma and one from Malela.

***Mesotrichia torrida* (Westwood)**

The female is large and dark, easily confused with *combusta* Smith, or with *subcombusta*, or *perpunctata*, new species. The thorax is a little shorter and a little narrower than that of *subcombusta* and *combusta*; the abdomen a little longer. Green and copper iridescence of wings about same as that of *combusta*, but without the blue and violet iridescence of *subcombusta* or *perpunctata*. Punctures very dense on sides of abdomen, sparse on tergum; very slight indication of red hairs in anal tuft.

Friese reported (1909) males and females from West Africa (Cameroon, Congo, Gold Coast) and also several from Uganda, East Africa. The female from the Gold Coast has green iridescent wings, the others more blue iridescence. The specimens I have determined as *torrida* have the wings with the green and fuscous iridescence. It may be

that on closer inspection the Friese specimens will be found to be of two species. In 1922, he described three females from the Gold Coast as a new variety, *gramineipennis*, as similar to *M. torrida*, but wings deep green instead of dark blue iridescent: head and thorax thickly covered with long black hair, underside of antennæ golden brown. Length 27-28 mm. Breadth 11 mm.

The male *M. torrida* from the F. Smith collection, now held by T. D. A. Cockerell, has been examined. See Fig. 4 for genitalia of specimen from Kwamouth.

The following specimens are in the present collection. one female and 9 males from Medje; 16 females and 3 males from Avakubi; 3 males from Kwamouth, just south of the Rain Forest; 2 males from Stanleyville and 1 from Poko.

Mesotrichia varipes (Smith)

Females are without the pouch in the first abdominal segment. Two specimens were taken at Stanleyville, in the Rain Forest, April, and were temporarily paired off by me with *M. lepeletieri* Enderlein, of which we have three specimens from Stanleyville taken in March 1915. They are black, with whitish hair on collar, thorax, pleuræ, first abdominal segment, and on sides of last two abdominal segments. Length 24 mm. Wing 21 mm. Smith gives the length 26 mm., abdomen 12 mm. wide, wing 22 mm. Friese lists females from Sierra Leone, Fernando Po; also from Cameroons, Gabun, in West Africa, and from Dumisa (Natal).

Dusmet, 1924, discussed the relationship of *varipes* Smith and *africana* Fabricius, concluding that they are not, as Vachal and Dalla Torre thought, opposite sexes of one species. The three specimens of *africana* Fabricius (male) in the present collection were taken at Banana in the extreme lower Congo. Figure 24 is a copy of Maidl's figure of the genitalia of the male *varipes* Smith. It will be seen to somewhat resemble that of Fig. 7 or Fig. 26, *lepeletieri* Enderlein, except that it shows no hairs on the sagittæ, very few on stipites, and that the sagittæ appear to arch higher than the stipites; and the whole genitalia to be more elongated, having a narrower base.

Mesotrichia varipes parva (Enderlein)

Females are without the pouch in first abdominal segment. The one small-sized specimen from Bafwasende, September, seems to tally with the size of Dusmet's specimen from Itime, Spanish Guinea, and it

has the greatest width between the eyes, $3\frac{1}{2}$ mm., the width given for this subspecies. However, there are two specimens, one from Avakubi, October, and one from Niangara, November, which are practically the same size as *varipes* Smith, but agree in the description of *varipes parva* Enderlein, by having the long dirty yellow-brown hairs on segment 6 but absent from segment 5. These specimens, which presumably are *varipes parva*, are black; with dull dirty tan hair on head, thorax, first abdominal segment, small patch on sides of second segment, lateral tufts on sixth abdominal segment; rufous on tibiae and tarsi; short reddish anal tuft; black fringe on segments 3, 4 and 5; abdomen moderately covered with short black hair more sparse along median line. Width between eyes 4 mm. Length 23 mm. Width of abdomen 10 mm. Wing length 19 mm. Enderlein's specimen, 20 mm. long, was taken in North Cameroons, Johann-Albrechts Heights. Dusmet gives the size of the specimen from Itime, Spanish Guinea, as: length 19 mm, breadth of abdomen 10 mm., wing length 17 mm.

Mesotrichia africana (Fabricius)

Males are distinguished by the disk of brilliant canary-yellow hairs on mesonotum and scutellum and on the first abdominal segment. Other segments of the abdomen have an olive-green color due to the covering of very short golden hairs, somewhat mixed with black hair, on the black integument. The hairs are a little longer at the sides of the last segments. Hair of pronotum, pleurae and legs dark brown. Yellow hairs mixed in on vertex; white on cheeks. Wings iridescent copper, subhyaline. Legs dark, with dark hair; some yellow mixed on all tibiae, and on basitarsi. Length 21 mm.; breadth of abdomen 10 mm.; wing length 18 mm. Genitalia: Fig. 5. There are three males from Banana, August and September.

Friese believes the female may be *M. obscurata* Smith rather than *M. varipes* Smith.

Mesotrichia africana conradti (Enderlein)

MALE. —A medium-sized dark bee distinguished by the bright reddish-brown hairs on mesonotum, and scutellum and first abdominal segment, and the dark olive-green color of rest of abdomen.

Head.—Black; coarsely punctured; clypeus with ochraceous hairs; front and supra-clypeal area with darker hairs; vertex with dark brown hair; some yellow above eyes; cheeks with light ochraceous hairs. Antennae dark; flagellum from fourth joint on dark red-brown beneath; third joint almost as long as three following. Width between eyes $3\frac{1}{2}$ mm., mandibles toothed and deeply grooved.

Thorax.—Black; long black hair with some yellow intermingling, densely covering pronotum, tegulae and pleurae; reddish-brown hair densely covers mesonotum and scutellum except for very narrow medial shiny streak; narrow band of dark-brown hair from postscutellum margins the sharp edge of the thorax.

Abdomen.—Very coarsely and closely punctured; pubescence on segment 1 bright reddish brown with an orange tinge; segments 2 to 7 covered with very short black and yellow hairs giving a dark bronze-green or dark olive-green color; sparse tufting of black hairs on sides of segments 5, 6 and 7.

Legs.—Black, except base of claws and last tarsal segment which are reddish brown. Hair brown, almost black; outer margin of basitarsus I with few light hairs; femora almost bare.

Wings.—Dark smoky brown, with blue, violet and golden iridescence, latter predominating over basal half. Length 18 mm.

Genitalia.—Shown in Fig. 6. Note the close similarity to *M. africana*, Fig. 5, except for relative proportions of length and width

One male from Niangara, November 1910.

Mesotrichia lepeletieri (Enderlein)

MALE. Head black; face with short gray to dark gray hair; behind the vertex and above the cheeks short yellow hair; lower cheeks with long gray hair. Antennae black, joints 4 to 13 rust-red below. Distinguished by the triangular disk of brilliant yellow hair on the thorax, margined by a dense growth of very dark brown-hair on pronotum, pleurae, and scutellum. Underside of thorax dark brown-haired. All abdominal segments are thickly covered with very short yellow hairs which over the black integument give a dark olive-green color. There are some longer yellow hairs on the anterior rim of the first segment and fringing the sides of all abdominal segments except the sixth and seventh, on which latter places the long hair is black. However, the median line of the last segments is more yellowish olive-green because of longer yellow hairs. The anal tuft is pale almost white. Underside of abdomen with dark brown hair; some long gray toward sides of segments 3, 4, and 5.

Legs.—Black with very dark brown hair. Tibiae and basitarsi I posteriorly fringed with long gray hair, and with short yellow hair on ventral side of other tarsal segments.

Length.—20 mm. Width of abdomen 10 mm. Wing length 19 mm.

Genitalia.—Shown in Fig. 7 compare favorably with Fig. 26, figured by Maidu. Note the similarity to the genitalia of *lepeletieri ruboris*, Fig. 8.

Three males from Stanleyville, March 1915.

Mesotrichia lepeletieri ruboris (Strand)

It is puzzling to know if the three specimens at hand are the sort Strand called *M. lepeletieri ruboris*. These are a red variety of *M. lepeletieri* but, upon examination with a lens, the hairs of the abdomen which Strand says are reddish on his specimen are here found to be a pure golden yellow. Mixed with black hairs, they give a very dark olive-green cast to the abdomen. The pubescence of the thorax corresponding to the

yellow region of *M. lepeletieri* is red on these Congo specimens. Assuming that Strand did not observe that the hairs of the abdomen were yellow rather than red, I am identifying these specimens as *lepeletieri ruboris*. His description is insufficient to allow for a more definite determination. See Fig. 8 for genitalia.

There is one male from each of the following: Leopoldville, July; Avakubi, October; and Niangara, November.

***Mesotrichia imitator* (Smith)**

The male of this species is probably described under another name.

Forty-eight females were taken at six localities scattered from the estuary to the headwaters of the Congo: Banana, April, July, August, September; Stanleyville, March and April; Avakubi, October and November; Medje, July; Poko, August; and Niangara, November.

***Mesotrichia albiceps* (Fabricius)**

M. albiceps is the miniature of *imitator*, but, unlike *imitator*, it does not bear the abdominal pouch. It is rather remarkable that the male of this very common and wide-spread species is not known. Vachal states that his *nigricans* (1910) may possibly be the male. Among the 113 specimens obtained from sixteen of the twenty-two localities there is a variation in size ranging from 13 mm. to 17 mm. Though there is no definite correlation between size and locality, on the whole those from the lower regions of the Congo were the smaller. The localities represented are Banana, July, August, September; Malela, July; Zambi, June; Matadi, June; Boma, June; Thysville, June; Kinshasa, May; Lisala, May; Stanleyville, March, April, May; Batama, September; Avakubi, October; Medje, July; Niangara, November; Vankerekhovenville, April; Faradje, March, April, November, and December; and Garamba, July.

***Mesotrichia nigrita* (Fabricius)**

The males and females are large and robust, and entirely different in appearance.

FEMALE.—Black; with black hair except dirty cream-colored hair on face from posterior ocelli to labrum, on cheeks, tibiae and tarsi I, pleurae and mesosternum, and tufts on sides of segments 2 to 6 of abdomen. Length 30 mm. Wings dark with brown and violet iridescence, 27 mm. long.

MALE.—Dark brown, except marginal border and median line of clypeus, supraclypeal area, under side of antenna, basal mandibular spots. Entire body densely covered with light red-brown hair. Wings golden, hyaline; 28 mm. long. Body length 33-37 mm. Genitalia: Fig. 9, from a medium-sized specimen from Stanleyville.

The collection contains specimens from Malela, July and August; Zambi, April; Stanleyville, Jan. to April; Bafwasende, Nov.; Avakubi, Oct.; Gamangui, Feb.; Medje, April; and Niangara, November.

***Mesotrichia cloti* (Vachal)**

FEMALE.—Black; white pubescence on face, pleurae, first tibiae and in small marginal tufts at sides of abdominal segments 2 to 5. Wings dark, with blue and green iridescence. Length 23–26 mm. Wings 21 mm.

There are specimens from Stanleyville, April; Avakubi, October; and Niangara, November.

***Mesotrichia luteola* (Lepelletier)**

The large number of medium-sized olive-green males and the black females with yellow hair on thorax and first abdominal segment called for a great deal of study. Locality sorting brought out two major groups among the females: one having brighter, clearer yellow pubescence, wings with somewhat more blue iridescence, and a shorter abdomen, all taken from June to September, from the lower Congo localities; and the other group having the more dingy yellow hair and the more distended abdomen, all from the upper districts of the Congo. This latter group could be sorted into lots according to size variation: 16 mm., 18–19 mm., 22 mm. The small and medium-sized specimens were entirely from two districts: Garamba and Faradje. It is very evident from the condition of the pubescence that the specimens were killed or preserved under different conditions. Those from the lower Congo localities were preserved dry, the others had been in a liquid medium. Just how much the color of the hair and wings was affected by the liquid is hard to judge. Further, different killing agents used on the two major lots may have caused a difference in the distention of the abdomen. The medium-sized bees of the more dingy color agreed in size and general form with the brighter-colored estuary group, which were determined as *M. luteola* Lepelletier. The extremes of size variation are no greater in this lot of bees than were found among *M. albiceps* and other species. There seems to be no morphological features upon which to base different species or subspecies. However, these may well represent different races if the methods of killing and preserving do not account for the group variations. The two specimens from Coquilhatville, taken May 19, 1915, have darker and duller yellow pubescence on the thorax and first abdominal segment.

The males fall into two major groups, also locality groups, showing the same difference in color tone and condition of the yellow pubescence

presumably due to the different killing or preserving agents used. The examination and comparison of genitalia showed no perceptible difference between the specimens of the two localities, other than normal variations. There are slight variations in the pale tegumentous markings on the clypeus and basal spots on the labrum. Again, it is judged that these are merely racial differences. Microscopic examination of a half dozen genitalia showed their similarity of form.

FEMALE (of lower Congo localities, resembling specimen of *M. luteola* in Cockerell's collection, obtained from F. Smith collection).—Head, black; pubescence black or very dark brown; very closely punctate except on malar space, clypeal margin and median clypeal line, and also more sparse lateral to the posterior ocelli. Antennae black; reddish on under side from segment 4 to tip. Width between eyes $3\frac{1}{2}$ mm. Thorax, black; pubescence bright yellow on notum, pleura and surrounding the tegulae, leaving a small bare highly polished unpunctured central disk; sternum with very dark brown hairs. Abdomen: Segment 1 yellow-haired above; other segments and underside very sparingly covered with short black pubescence; anal tuft of short reddish hairs. Legs, black, with very dark brown pubescence. Wings: Coppery hyaline base, darker and with blue and violet iridescence in apical half; length 17mm. Length: 18–20 mm.

MALE (of lower estuary localities).—Black, except: antennae beneath, anterior margin and medial line of clypeus, two spots on labrum, which are reddish yellow, and base of claws which are reddish. Width between eyes 3 mm. Pubescence on head, notum, and sides of thorax, tibiae and basitarsi I and upper area of tibiae II and III, rather long and thick, yellow. Tergum with sparse covering of short yellow hairs mixed with black or very dark brown, giving an olive-green cast. Lateral fringe on last segments black; anal tuft yellow. Ventral side of body with sparse covering of very dark brown hair; tarsi II and III with dark brown hair. Wings are subhyaline, dusky golden with violet iridescence. Wing: 15 mm. Length: 16–18 mm. Genitalia shown in Fig. 10 and Fig. 11, taken from the differing lots from widely separated localities, from Boma and Garamba respectively, indicate very slight variation. They are similar to Fig. 22 of *luteola*, copied from Maidl. He has evidently erroneously credited this species to Vachal rather than to Lepeletier.

Specimens.—(a.) Those with bright yellow pubescence, bluer wings, and shorter abdomen were from the lower river localities, points south of the Equatorial Rain Forest, as follows: Banana, July to September; Malela, July, August; Boma, June; Matadi, June; and a female from Lisala (Rain Forest Region), May. (b.) Those with dingy yellow hairs, more elongate abdomen, from north of the Equatorial Rain Forest: Faradje, March, Nov. and Dec.; Garamba, June, July; and a female from Niangara, November. (c.) Like *b* but from the Rain Forest region: one female from Stanleyville; one from Medje, August; and two having yellow hairs more orange from Coquilhatville.

Mesotrichia langi, new species

MALE.—Type from Faradje, April 1911.

Head.—Black; antennae beneath, except segments 2 and 3, testaceous. Dark hair on face rather long and not dense, mixed with some gray; area surrounding upper half of eyes thinly covered with very short yellow hair; labrum and mandibles with golden-brown hair. Clypeus has shining lower margin, lateral edges irregularly ridged, shining, meeting on short horizontal line below supra-clypeal area; slightly raised keel at base of anterior ocellus. Head closely and coarsely punctate. Labrum grooved and toothed. Greatest distance between eyes $2\frac{1}{2}$ mm.; eyes slightly converging above and below.

Thorax.—Black; notum with thick covering of yellow hair except for very narrow median longitudinal stripe which is bald and shining. Tegulae covered with yellow hairs. Pleurae and ventral side with black hairs.

Abdomen.—Black; well covered with fine punctures. Yellow pubescence on segment 1 and extending on to segment 2 moderately long; all yellow pubescence on other segments very short and very sparse. Black fringe on sides of last abdominal segments; short black pubescence across last two segments.

Legs.—Black, with rather short black hairs except longer on each basitarsus.

Wings.—Smoky, with golden iridescence over basal half, rose and copper over apical half. 11 mm. long.

Length.—14 mm.

Genitalia.—Fig. 12. Very similar to Fig. 20 of *M. anicula* Vachal, copied from Maidl

Mesotrichia nigricaula, new species

MALE.—Small, quite similar to *divisa* Klug, but differs by having flagellum and scape light below, by having hair on tarsi and tibiae II yellow, and having the hairs of last abdominal segment dark.

Type and Paratype.—From Garamba, June–July 1912.

Head.—Black, except antennae beneath, spot at base of mandibles, lower margin of clypeus, which are yellow. Densely covered with golden-yellow pubescence. Labrum and base of mandibles coarsely punctate. Greatest diameter between eyes 2 mm.

Thorax.—Black; notum and pleurae densely covered with golden-yellow hairs; small central dorsal disk bare, shining; sternum rather bare with very few short dark brown hairs mixed with yellow.

Abdomen.—Black; closely punctate, more finely and densely so at sides; long yellow hairs on segment 1, short sparse covering on 2 and 3, a few very short black hairs on 4 and 5, longer black hairs fringing on last segments. Venter almost bare, few short yellow hairs mixed with dark; some longer yellow hair near sides of last segments.

Legs.—Dark mahogany; last tarsal segments and base of claws reddish. Femora almost bare; first legs with long yellow hairs on tibiae and tarsi; tibiae II and III with long yellow hairs, except longitudinal streak of short dark brown near distal end; on tarsi II and III a mixture of long yellow golden-brown and dark brown hairs.

Wings.—Subhyaline, with gold, violet and some blue iridescence. Length 12 mm.

Length.—13–14 mm.

Genitalia.—Fig. 13; rather similar to that of Fig. 25, of *M. divisa* Klug.

Mesotrichia stanleyi, new species

Ten males from Stanleyville, March and April, run very close to the description of *M. gabonica* Gribodo, which description, 1894 (quoted in Friese, 1909), fails to mention a large thick blunt testaceous tibial spur on leg III.

They may be easily confused with *calcarata*, new species, but are slightly more robust. *M. gabonica* has been found at Gabun, Congo, and Sierra Leone.

MALE.—Type from Stanleyville, April 1915.

Body.—Black, except scape, and flagellum past third segment, lateral marginal spots on clypeus, basal spots on mandibles, which are light testaceous; while apical part of last tarsal segments and base of claws are red. Thick covering of yellow hairs with some black mixed in on head, thorax and abdomen, giving a yellowish-green color; narrow median bald stripe on thorax; hairs of abdominal segments 3 to 6 shorter and more reclining, and sparse through median line causing a dark streak. Anal tuft very light yellow, bordered with long black hair. Ventral side of thorax and abdomen with sparse covering of golden-brown pubescence, necktie tuft on prosternum; ventral abdominal segments have a thin marginal fringe of long light yellow hairs except through medial area.

Legs.—All tibiae with long yellow hairs; however, very short dark brown hairs form a longitudinal apical streak 1 mm. long on second tibiae, and a similar streak 2 mm. long on third tibiae; tarsi with fringe of golden yellow, some long dark brown hair mixed with the golden yellow on tarsi II, and considerable brown hair mixed in on tarsi III. A heavy, blunt, testaceous, tibial spur 2 mm. long, on legs III.

Wing.—Hyaline, marginal cell and first submarginal clouded; golden, with some rose and violet iridescence in apical third. 14 mm. long.

Length.—15–16 mm., width of abdomen 7–7½ mm., intertegular distance 5½–6 mm.

Genitalia. —Fig. 14.

Mesotrichia calcarata, new species

MALE.—Type from Garamba, June–July 1916. A small bee of olive-green cast, similar to description of *M. gabonica* and very similar to *M. stanleyi*, new species, which latter possess also the heavy blunt testaceous tibial spur on the third legs. *M. calcarata* male is distinguished from *M. stanleyi* by being slightly smaller and less robust, wings showing slightly more cloudiness at apex, distance between eyes being slightly less, width of head slightly less, being 4 mm., while *stanleyi* is 4½ mm.

Head.—Black, except evanescent lateral spots on labrum, basal spots on mandibles, antennae beneath, except segments 2 and 3, which are testaceous. Malar space reduced; labrum with proximal concave ridge, distal portion convex, closely punctured, sharply toothed. Greatest distance between eyes 2.5 mm., 2 mm. at vertex, from 1.5 to 1.7 mm. at base. Hair of face yellow, rather long, with some black hair intermingling. Face closely punctured. Hair of cheeks and occiput long. Width of head 4 mm.

Thorax.—Black; dorsum and pleurae and tegulae well covered with long yellow hairs intermingled with black; closely punctured except on narrow, short medial

bare, shining ridge. Ventral surface with sparse covering of golden-brown hair. Tegulae show central bald shiny spot. Width between tegulae 5 mm.

Abdomen.—Closely punctured and covered with short yellow hair with some black, though more sparing through medial line; hair longer on segment 1 and on sides of 2 and on sides of 5 and 6, and fringe long, yellow, flanked by fringe of long black hair. Width 6 mm.

Legs.—Black, except last tarsal segment and bases of claws of all legs, dark red. Femora practically bare; tibiae with rather long yellow hair; distal streak of very short dark hair on tibiae II about 1 mm. long; streak on tibiae III about 2 mm. long; basitarsi I and II with long fringe of golden-yellow hairs, some dark brown intermingling; basitarsi III with much dark brown on dorsal side, entirely dark brown on under side. Long, thick, blunt, testaceous spur on tibiae III.

Wings.—Semi-hyaline, golden with some rose and slight amount of blue iridescence. Length 12 mm.

Length.—13-14 mm.

Genitalia.—Fig. 15.

FEMALE.—Allotype from Garamba, July 1912. This is a small black bee with yellow hair on thorax and first abdominal segment, central bald thoracic disk, dusky wings, with green and purple iridescence at apex, semi-hyaline over basal half where iridescence is rose and gold. Does not bear abdominal pouch. S. A. Rohwer reported on this specimen sent for comparison with National Museum specimens, "nearest to *M. scionensis* Grib, determined by Friese, but it lacks lateral oblique ridges on clypeus and has the tergites more closely sculptured."

Head.—Black, except dark testaceous on under side of flagellum from the third segment to tip. Malar space greatly reduced. Punctures very close and rather coarse. Malar space, lower central margin of clypeus, apical part of mandibles, base of supra-clypeal area, unpunctured, shining. Eyes light, greatest distance between them 3 mm., converging to 2.5 mm. Thin covering of a mixture of black and dirty yellowish hairs over face, very sparse or worn off across vertex and super-orbital area, black hair on occiput and cheeks. Labrum with shining golden-brown fringe; small medial tubercle. Mandibles grooved, with few golden-brown hairs.

Thorax.—Black; with golden-yellow hairs on dorsum and pleurae, black on ventral side. Bald, shiny, unpunctured dorsal disk about 1.5 mm. in diameter. Width between tegulae 4 mm.

Abdomen.—Black; well punctured, more closely so along sides; sparse covering of short yellow hairs on first segment, some short black hairs on sides of segments 2, 3 and 4, slightly longer fringe, rather brownish, on segments 5 and 6, small group of short reddish hairs for anal tuft. Width 7 mm.

Legs.—Black, except last tarsal segment and bases of claws reddish. Hair black or very dark brown; ventral side of basitarsus I golden brown.

Wings.—Dusky, with green and some purple iridescence over apical half; semi-hyaline, golden with some rose iridescence over basal half. Length 13 mm.

Length.—14 mm.

There are 7 males and 20 females from Garamba, June and July; 5 females from Faradje, Nov., Dec.; and the following males: 2, Banana, Aug., Sept.; 3, Boma, June; 1, Matadi, June; 4, Stanleyville, April; and 2 from Avakubi, October.



Fig. 17.
M. leucothorax
DeGeer



Fig. 18.
M. olivacea
Smith



Fig. 19.
M. calens
Lepelletier



Fig. 20.
M. anicula
Vachal



Fig. 21.
M. flavo-bicincta
Gribodo



Fig. 22.
M. luteola
Lepelletier



Fig. 23
M. leucothoracoides
Maidl



Fig. 24.
M. varipes
Smith



Fig. 25.
M. divisa
Klug



Fig. 26.
M. lepeletieri
Enderlein



Fig. 27.
M. flayorufa
DeGeer



Fig. 28.
M. pseudoleucothorax
Maidl

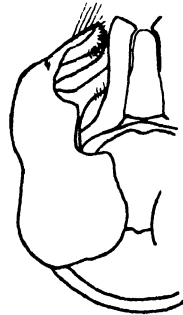


Fig. 29.
M. combusta
Smith

Figs. 17 to 29. Genitalia of African species of *Mesotrichia* figured by Maidl in 'Die Xylocopen (Holzbienen) des Wiener Hofmuseums,' 1912.

***Xylocopa chiyakensis* (Cockerell)**

The species *chiyakensis* undoubtedly belongs to *Xylocopa* rather than to *Mesotrichia*. The large, robust, black female does not have the abdominal pouch, which is a feature of almost all of the species of *Mesotrichia*. Other facts which indicate that it is intermediate between *Xylocopa* proper and the *Mesotrichia* group, or belongs to *Xylocopa s. str.*, are that the metathorax is convex, rather than concave, and that the margin of the scutellum is not as sharp as usual in the *Mesotrichia* group. The males also show the convex metathorax. Their genitalia are more nearly like the general form of those of the African forms of *X. s. str.* figured in Maidl, for instance, *X. tarsata* or *X. gaullei*.

The female specimen of *inconstans* Smith from Abyssinia, (Sayansiti), determined by Gribodo, in the Cockerell collection, formerly of the F. Smith collection, has the convex metathorax of *Xylocopa*, the less acute margin of the scutellum, and does not have the abdominal pouch. This pouch, wherein may be found mites of the genus *Paragreenia*, has been found in all of the larger sized species of *Mesotrichia*, except *M. varipes* Sm., *M. varipes parva* Enderlein, and in all of the smaller species, except *M. albiceps* Fabricius and *M. calcarata*, new species.

Friese, 1909, considers the female *chiyakensis* (Cockerell), 1908, as merely a yellow form of *inconstans* Smith, and misquotes Cockerell in respect to his assertion concerning the presence of yellow pubescence on the first abdominal segment. Cockerell distinctly says that there is yellow hair on that segment and contrasts *chiyakensis* with *flavescens* Vachal, which latter form has segment 1 with black hair. Friese (page 253) adds *inconstans* var. *flavocincta* on the basis of the scutellum and segment 1 being yellow-haired. Accordingly, *flavocincta* is a synonym of *chiyakensis* (Cockerell).

We may assume that the five males taken on the same dates at the same localities with the nine *chiyakensis* females are the *chiyakensis* males. They differ from the Radoszkowski (1876) description of the male of *inconstans* Smith by having a light yellow spot at the base of the mandibles, by the yellow pubescence not being bright ("vive"), but rather a reddish or brownish yellow—in fact it is the buckthorn brown of Ridgway's 'Color Standards and Nomenclature.' Pubescence on inner side of tibiae and basitarsi III is dark brown; that of a median streak on outer side of tibiae III, lateral margins of last four abdominal segments, anal tuft, and venter, a reddish brown. Length: 25 mm. to 32 mm. A specimen from Faradje, November 1912, had the second cubital cell divided, the small basal cell resulting forming a cell about twice as long as broad. The

genitalia of *Xylocopa chiyakensis*, from a specimen from Garamba, are shown in Fig. 16.

From the description of the male *inconstans*, I judge that it is much lighter than the male *chiyakensis*, though otherwise rather similar.

Specimens were obtained from the region north of the Equatorial Rain Forest as follows: 5 females and 3 males from Garamba, June, July; and 4 females and 2 males from Faradje, October to January.

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56.82 (119:729 1)

BONES OF BIRDS FROM THE CIEGO MONTERO
DEPOSIT OF CUBA

BY ALEXANDER WETMORE

Bones of birds collected from deposits in springs at the Baños de Ciego Montero, Cuba (thirty miles from Cienfuegos) by Mr. Barnum Brown and Prof. Carlos de la Torre in 1910 and 1918, comprise fragmentary material which though in small amount is of considerable importance. After examination of the remarkable mammalian forms that come from these same deposits, it is to be regretted that conditions did not permit the preservation of a greater amount of material representative of the prehistoric avifauna of Cuba, since in the few remains available there are two species that have not been found in modern times in the island.

The specimens examined are dark and stained, except the bones of the domestic fowl, which are light in color and obviously of recent intrusion. The older bones are supposed to be of Pleistocene age.

Following is a list of the material identified.

Ardeidæ***Casmerodius albus* (Linnaeus)**

The egret is included on the basis of a left coracoid that shows a certain amount of abrasion, and the broken proximal end of a left tibio-tarsus. The coracoid is not so heavily stained as some of the other fragments but appears to be of ancient deposit.

The coracoid of the present species may be recognized among those of other North American and West Indian herons (save possibly *Ardea occidentalis*, of which no skeleton is available at present) by the presence of a pneumatic foramen situated at the proximal inner angle of the bone immediately above the excavated articular surface that attaches to the sternum. A depression that surrounds this foramen is elongate-elliptical in outline and is about four millimeters in length. The amount of ossification in the bottom of this depression varies, so that the opening is sometimes single or more often divided in the various specimens that have

been examined. In the bone from Ciego Montero two small opening lead to the interior. The depression for the foramen is concealed when viewed from in front by a slight expansion at the base of the bone but is readily seen from the inner side or from behind.

Current practice includes the egrets of the World as geographic races of one wide-ranging group distinguished by differences in size, length of the dorsal plumes, and less certainly by the color of the soft parts, distinctions all more or less variable. After careful comparison of a skeleton of *C. albus timoriensis* from eastern Borneo, with a series of *egretta* from the United States, I am unable to find skeletal characters, save of size, that definitely separate these two. In *timoriensis* the transpalatine process is somewhat more produced and the distal portion of the lachrymal more attenuate, but certain specimens of *egretta* approach it in these respects. Skeletons of the other forms are not available at present.

The bones from Ciego Montero resemble in size those of the egret found today in Cuba and may be called *Casmerodius albus egretta*.¹ Barbour² states that this bird in recent years has been greatly reduced by plume-hunters.

***Ixobrychus exilis* (Gmelin)**

The upper half of a right humerus comes from a least bittern similar to the modern bird.

Ciconiidae

***Jabiru mycteria* (Lichtenstein)**

The jabiru is represented by the upper third or more of a right tarso-metatarsus and the lower end of a left tibio-tarsus broken off above the condyles. These fragments are well preserved and are uniformly stained so that they appear dark brown.

This species during historic times has been known to range from southern Mexico south through Central and South America as far as Argentina, and has been recorded accidentally as far as south central Texas. It has not been known from the West Indies, so that the bones under discussion constitute a new record, not alone for Cuba but for the entire group of the Antillean Islands.

¹The question of the subspecies of egrets has been treated recently by the following authors: Hartert, Jourdain, Tiechurst, and Witherby, *Hand-List of British Birds*, 1912, p. 123; B. O. U. *List of British Birds*, Second Edition, 1915, p. 193; Oberholser, H. C., *Auk*, 1919, pp. 557-558; Hartert, *Vog. Pal. Faun.*, vol. 2, March, 1920, pp. 1236-1239.

²Barbour, Thomas, *Birds of Cuba*, *Mem. Nuttall Ornith. Club*, No. 6, June, 1923, p. 28.

Sellards¹ has described a stork-like bird from Vero, Florida, as *Jabiru weillsi*,—remarking that the allocation of the species to the genus *Jabiru* is provisional,—from wing bones which are said to be longer than in *Jabiru mycteria* and to exhibit differences in form. Its distinctness in point of size may be open to question since Dr. Sellards gives the total length of his type specimen, a humerus, as 280 millimeters, while there is in the collection of the U. S. National Museum a skin (Cat. No. 212,989) of an adult male of *Jabiru mycteria* with humeri preserved intact in which a careful measurement (made without removing the bones from the skin) gives a humeral length of 280 millimeters, exactly equivalent to that recorded for the bird described as an extinct form.

Anatidæ

Anas platyrhynchos (Linnæus)

A left femur with the head gone and the distal end somewhat broken is identical in form with that of the modern mallard duck. Barbour² remarks that the mallard has been recorded only by Gundlach, who noted a flock near Cárdenas in 1850, but that the species must appear from time to time since it is known to the professional hunters of Mariel and Lake Ariguanabo.

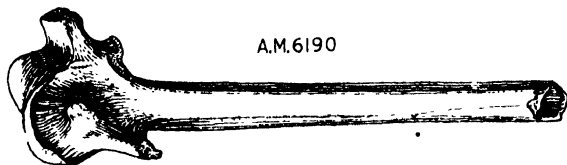


Fig. 1.



Fig. 2.

Fig. 1.—Inner view of left metacarpal of *Geranoaetus melanoleucus*. (Natural size.)

Fig. 2.—End view of trochlea of left metacarpal in *Geranoaetus melanoleucus* (Natural size.)

Accipitridæ

Geranoaetus melanoleucus (Vieillot)

The greater part of a left carpo-metacarpus (Amer. Mus. No. 6190) with the distal end and the greater part of metacarpal 3 missing (Figs. 1 and 2³) is exactly similar to *Geranoaetus melanoleucus* and is identified as

¹Eighth Annual Rep. Florida State Geol. Surv., 1916, pp. 146-147, Pl. xxvi, Figs. 1-4.

²Barbour, Thomas, Birds of Cuba, Mem. Nuttall Ornith. Club, No. 6, June, 1923, p. 35.

³Drawings made by Sydney Prentice.

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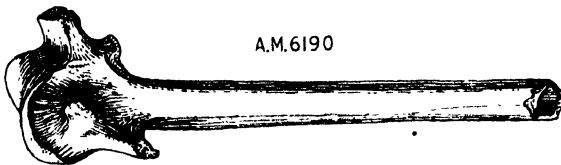


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³Drawings made by Sydney Prentice.

that species. There is associated with it the ungual phalanx of a buteonid of the proper size to belong to this same species.

This record adds another species to the Cuban bird-list hitherto unknown from that island or in fact from anywhere in the West Indies, the range of this eagle today being confined entirely to South America where it is common from northern Argentina south to the Strait of Magellan and occurs northward in the mountains to Colombia and Venezuela.

An eagle of similar form is recorded by L. H. Miller¹ from Pleistocene deposits in Hawver Cave, California. In a previous paper² I have cited Doctor Miller as authority for the definite occurrence of *melanoleucus* at the point indicated, but learn that I have misinterpreted the meaning of the author quoted (compare pages 75 and 92-93 in his account), since he has written me, under date of November 4, 1926, that the "material was not to my mind sufficiently perfect to record the species as a fossil. . . . It may be the species *melanoleucus* . . . but . . . might be something else." The present writer takes this opportunity to point out his error in citation of Doctor Miller's paper.

Phasianidæ

Gallus gallus (Linnæus)

The domestic fowl is represented by a nearly complete cranium that is light in color and evidently modern. In point of time it has no apparent connection with the other avian remains as it is obviously of recent deposit.

Rallidæ

Gallinula chloropus (Linnæus)

The distal end of a right tibio-tarsus represents a Florida gallinule of small size being equal in dimension to the female in this species.

Psittacidæ

Ara tricolor Bechstein

The proximal half of a right metacarpal apparently belongs to the Cuban macaw. The second metacarpal is broken near the middle, while the third is missing entirely, save where fused with the second. The processes and condyles at the proximal end of the bone show more or

¹Univ. Calif. Publ. Geol., vol. 7, October 12, 1912, pp. 75, 92-93, 95, 97, 114.

²Ann. Carnegie Mus., vol. 16, April 10, 1926, p. 406.

less wear and abrasion. This fragment agrees in general characters with the metacarpals of such macaws as are at hand for comparison. It represents a form larger than *Ara severa* but smaller than the large species of the genus. No skeletal material of *Ara tricolor* is at hand but from an examination of skins it would seem that the bone is of the proper size. On these grounds, then, it has been called *Ara tricolor*.

The fragment of bone preserved has no indication of the external groove for the reception of the tendon of the *extensor digitorum communis*. In other macaws examined, with the exception of *Ara chloroptera*, this groove is evident for about the distal three-fifths of the bone. The lower surface of the third metacarpal at its extreme proximal end (where it is fused with the second metacarpal) is more roundly ridged and less flattened than in the other macaws at hand. Otherwise the fragment from Ciego Montero presents no notable differences in form when compared with *Ara severa*, *A. ararauna*, *A. chloroptera*, and *A. macao*.

56.82 (118:78.2)

ADDITIONAL SPECIMENS OF FOSSIL BIRDS FROM THE
UPPER TERTIARY DEPOSITS OF NEBRASKA

BY ALEXANDER WETMORE

Collections secured in the Miocene and Pliocene deposits of Sioux County, Nebraska, by Mr. A. Thomson in work for the American Museum of Natural History during the field seasons of 1926 and 1927, have included three bones of birds that have been placed in the writer's hands by Mr. Barnum Brown for study and identification. The records obtained have added importantly to the fossil avifauna of this region.

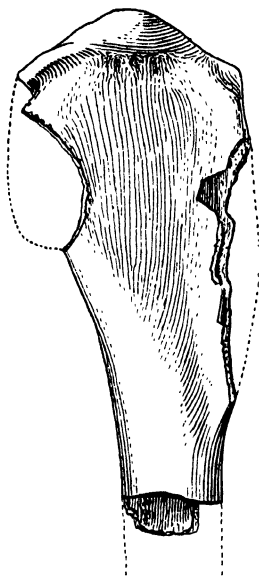
Drawings illustrating the crane have been made by Mr. Sydney Prentice.

Accipitridæ***Geranoaëtus contortus* Wetmore**

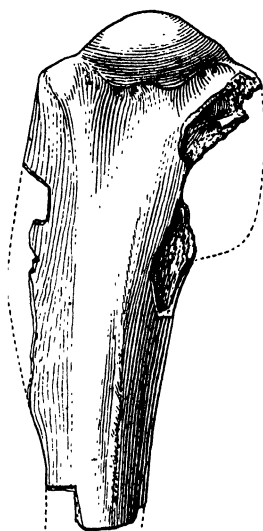
In the season of 1927 Mr. Thomson collected the lower part of a right metatarsus (Amer. Mus. Nat. Hist., Dept. Vert. Pal. No. 6981) from the lower Snake Creek beds (Upper Miocene) on Olcott Hill, that agrees with the type of *Geranoaëtus contortus* of similar age and is identified as that species. The specimen is heavily fossilized and is black in color except on the trochlea which are gray. It is complete for about the lower third. The smallest transverse diameter of the shaft measures 10 mm. and the transverse breadth across the trochlea is 23.1 mm. It is similar in form to the type of the species and is the second occurrence for the bird.

Megalornithidæ***Megalornis pratensis* (Meyer)**

A fragmentary left humerus from the Pliocene of the Upper Snake Creek formation (Amer. Mus. Nat. Hist., Dept. Vert. Pal. No. 6620) found in Quarry 7 in the Kilpatrick pasture, is in two parts and has slightly less than one third of the shaft missing from the center (Figs. 1 and 2). The upper section lacks the thin plate of the crista superior and the tuberculum internum, with the adjacent surface surrounding the pneumatic foramen. The lower portion is entire. The bone is fossilized



A.M. 6620



A.M. 6620

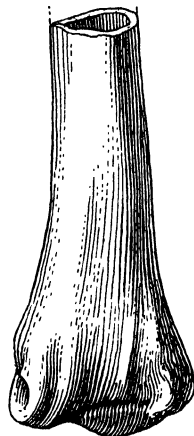
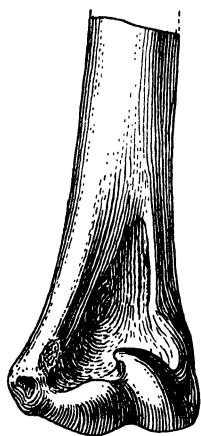


Fig. 1.—Left humerus of *Megalornis pratensis* from the Pliocene of Nebraska, anterior view. (Slightly more than two-thirds natural size.)

Fig. 2.—Left humerus of *Megalornis pratensis* from the Pliocene of Nebraska, posterior view. (Slightly more than two-thirds natural size.)

but has many checks and cracks that have been skilfully repaired so that the original form is preserved. It is dull white in color and shows a small amount of wear on projecting processes, which, however, retain the characters useful in identification.

On careful comparison it is found that the fossil agrees in form and dimensions with the living sandhill crane, being so closely similar to modern material that it may not be distinguished. Following are measurements that may be made from it together with similar dimensions taken from specimens numbered 820, 4355 and 19019, in the osteological collections of the United States National Museum. The sex of the modern birds is not known but it would appear that the first, being larger, is a male, and that the other two are females.

	FOSSIL	MODERN		
		No. 820	No. 4355	No. 19019
Breadth across distal trochlea.....	33.1	34.5	31.5	33.3
Transverse breadth of shaft below center.....	15.3	16.7	14.8	16.0
Transverse thickness at same point...	13.4	13.7	11.8	12.2
Length from upper margin of tuberculum externum to distal margin of crista superior.....	64.8	64.8	58.7	62.1

The gray cranes of North America in modern phase are separated by size into two groups, one containing the so-called little brown crane *Megalornis canadensis* (Linnæus) which nests in the far north and migrates south to Texas, California and Mexico, and the other the sandhill cranes, distinguished from the little brown crane by larger size, which breed from southern Canada south into the United States. Authorities differ as to the relationships of these two groups, some, as Hartert, Oberholser and Peters, considering them subspecifically related and others calling the large and small groups distinct species. In the present connection the writer does not care to enter into the question of subspecific relationships but as a matter of convenience treats the two as separate species.

According to J. L. Peters¹ the name *mexicana* of Müller, long applied to the sandhill crane, must be rejected, as it may not be identified. The next available name is *pratensis* of Meyer based on Bartram's account of the Florida bird. Peters gives the northern sandhill crane, which differs from the Florida form in color but agrees in size, the subspecific name *tabida*.

¹Auk, 1925, pp. 120-122.

The fossil from Nebraska, which is distinctly larger than the little brown crane, in accordance with the above is identified as *Megalornis pratensis* (Meyer), this being the specific name here accepted for sandhill cranes throughout their range. The fossil has great importance in indicating an extraordinary stability in osteological form since it demonstrates the presence in the Pliocene of a crane identical in humeral characters with the existing sandhill crane, giving this type of bird the longest line of unchanged descent at present known on the North American continent in the class Aves.

L. H. Miller has reported cranes of this type from the Pleistocene of Rancho La Brea and McKittrick, where he has found bones of varying dimensions indicating a possibility of two forms.

In the identification of this fossil I have had occasion to examine critically *Grus haydeni* Marsh¹ named from a fragmentary distal end of a left tibia collected by Dr. F. V. Hayden from "later Tertiary beds" of the Niobrara River, in the upper Missouri region. The exact age of the specimen is uncertain, as it has been ascribed to the Pliocene or questionably to the Pleistocene. From examination of a replica in plaster of the type, it appears that it has no valid characters to mark it from the sandhill crane. In modern bones the outer margin of the outer condyle, viewed from below, has an angular impression on its posterior portion that is not as well marked in the type of *haydeni*. The latter, however, shows wear sufficient to account for the difference. *Grus haydeni* Marsh is, therefore, reduced to a synonym of the modern *Megalornis pratensis*, with the statement that the fossil has the size of the living sandhill cranes.

Aramidæ

Aramus sp. indet.

In the season of 1927 Mr. Thomson secured the right tibio-tarsus (Amer. Mus. Nat. Hist., Dept. Vert. Pal. No. 6982) of a limpkin in the Pliocene of the Upper Snake Creek beds on Olcott Hill. The specimen is from a young individual in which the bone had not fully developed so that the head of the bone from immaturity had not yet ankylosed to the shaft, and is missing, and the upper end of the shaft appears spongy. The lower end has the various tubercles and grooves apparently in normal condition. It is slightly smaller and more slender than the average for *A. pictus*, a condition due perhaps to age. It measures 12.1 mm. transversely across the tubercles. This specimen is closely similar to the

¹Marsh, O. C., *Grus haydeni*, Amer. Journ. Sci., Ser. 2, Vol. 49, 1870, p. 214.

modern limpkin *Aramus pictus* and may be that species. The fact that the bone is highly immature makes certain identification inadvisable so that it is named here to genus only with the hope that more material may come to hand in later excavation. It is apparently typical *Aramus* and not *Aramornis* Wetmore¹ described from the Middle Miocene of this same area.

The present specimen is the second occurrence known for its family in fossil state. The modern *Aramus pictus pictus* is found in the interior of the peninsula of Florida and in the Okefinoke swamp in southern Georgia, and in an allied form *Aramus pictus dolosus* Peters, from Central Mexico south to Panama.

¹Amer. Mus. Nov., No. 211, March 11, 1926, p. 1.

56.76:19

TWO NEW FOSSIL AMPHIBIA OF ZOÖGEOGRAPHIC
IMPORTANCE FROM THE MIOCENE OF EUROPE

BY G. K. NOBLE

While recently studying the fossil Salientia and Caudata in the British Museum, through the kindness of Dr. F. A. Bather, I had the opportunity to examine the material described by Lydekker in his Catalogue (1890). Some of the fragmentary specimens referred to *Cryptobranchus scheuchzeri* (Holl) and another to *Rana meriani* Meyer have proved upon further study to belong to very different species. This material is of considerable zoögeographic interest, for it demonstrates that a large salamandrid of the genus *Tylotriton* and a large tree frog not closely related to *Hyla arborea* were both present in Europe during the Miocene.

Salamandridæ***Tylotriton primigenius*, new species**

TYPE.—Brit. Mus. 42742, a fragmentary skeleton on two slabs. Paratypes, Brit. Mus. 42741, a badly preserved skeleton better articulated than the type, and Brit. Mus. 42761, skull and scapula region crushed and poorly preserved.

HORIZON AND LOCALITY.—Upper Miocene, Eningen, Switzerland.

DIAGNOSIS.—Generic characters of *Tylotriton*: vertebræ opisthocæalous, a thick bony fronto-squamosal arch, maxillary reaching quadrate, pterygoid extending forward to maxillary, ribs long and pointed, the third bifid. Differs from *Tylotriton verrucosus*, and apparently from the other species of the genus in its larger size, greater development of secondary ossification on skull (the encrustations covering squamosal and quadrate regions as well as extending forward to nasals), broader anterior ramus of the pterygoid which is in extensive contact with the maxilla, and in different proportions of limbs, girdles, and ribs.

DESCRIPTION OF TYPE SPECIMEN.—The specimen lies partly embedded in a block of limestone with its ventral side down. The plane of fracture cuts directly across the upper part of the neural arches, the left-hand slab containing the greater part of the vertebræ, the right only the upper part of these structures. Only parts of the skull, ribs and limbs are present, but certain of these exhibit diagnostic characters.

The impression of the skull and of the fragments of bone preserved are shown in Fig. 1. Although these represent a frontal section of the skull at about the level of the dorsal surface of the pterygoid, a comparison with the ventral surface of the skull of *Tylotriton verrucosus* is instructive. It is clear that the maxillaries extend to the

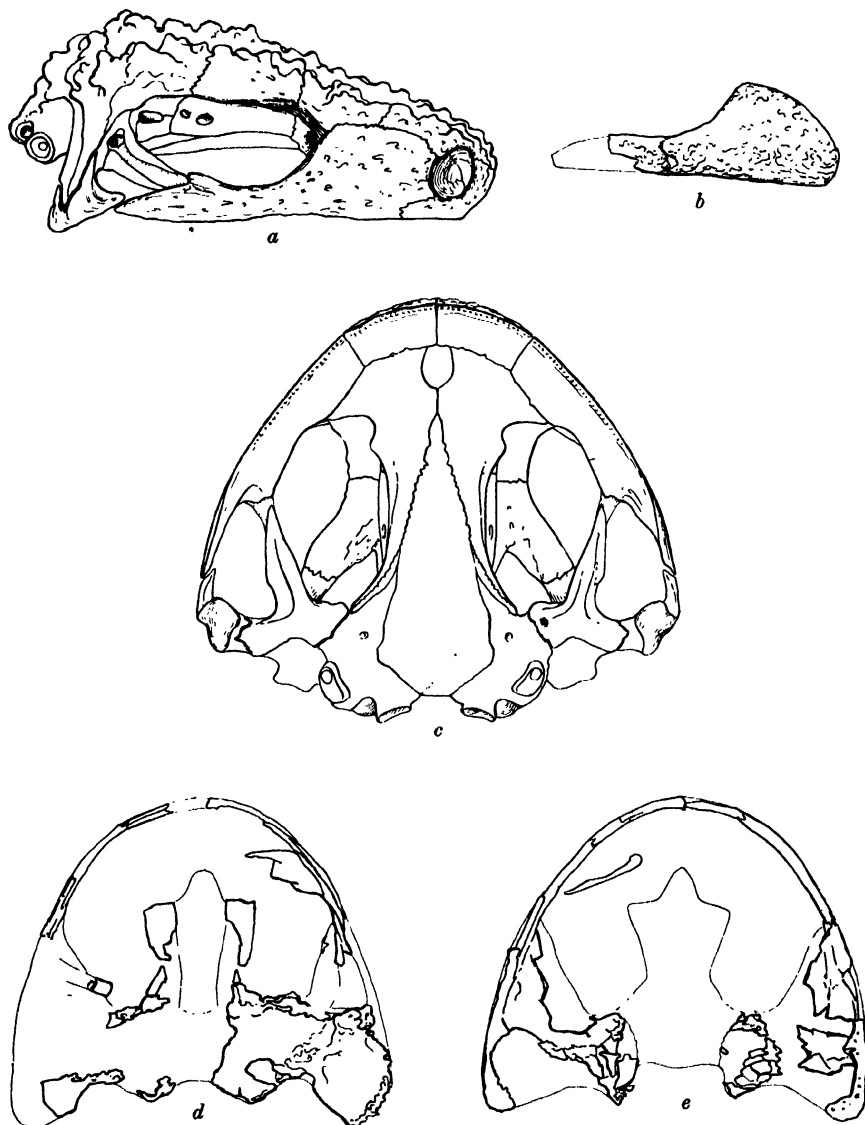


Fig. 1. Skull of *Tylotriton verrucosus* Anderson and *T. primigenius*, new species, compared.

- (a) *T. verrucosus*, lateral aspect.
- (b) *T. primigenius*, type, lateral aspect of right maxilla.
- (c) *T. verrucosus*, ventral view of skull of adult male.
- (d) *T. primigenius*, portions of skull shown on left slab of type specimen.
- (e) Same specimen, portions of skull shown on right slab.

In the fossil specimen, impressions are indicated by thin lines, bone by heavier ones.



Fig. 2. *Tylotriton primigenius*, new species, type specimen.

(a) Impression of the first vertebra and remains of the greater part of the second vertebra as shown on left slab; the dorsal part of the neural arch has been broken away.

(b) Third rib of right side, impression and bone fragments shown on the left and right slabs.

(c) Impression and bone fragments of right coraco-scapula and humerus, as shown on right slab.

(d) Left coraco-scapula and humerus, left slab. The impression of the margin of the first is indicated by the narrower line.

quadrate and the pterygoids meet the maxillaries as usually described in *Tylotriton*. As a matter of fact, the pterygoids do not quite reach the maxillaries in my specimen (Fig. 1c) of *T. verrucosus*, although it is an adult male. In the fossil described here the contact is a very broad one. The fossil agrees with *T. verrucosus* in possessing extensive spenethmoids, but it differs in having broad bony encrustations covering the quadrate region. In *T. verrucosus* encrustations are found on the squamosal, but not the quadrate (Fig. 1a). The right maxilla is exposed on the right slab. It differs somewhat in form from that of *T. verrucosus* (Fig. 1b).

The vertebrae, although considerably broken, are unquestionably opisthocœlous. This condition is best seen in the second vertebra on the left slab (Fig. 2a), but the first three vertebrae on the right show the same, and several fragments on the left can

be interpreted only as opisthocœlous. The plane of fracture passes through the neural arches and the opisthocœlous condition is most evident where a vertebra has fallen out leaving the ends of the adjacent ones visible.

The ribs are broken and scattered, no one being in place. It is clear from the fragments and the good impressions of ribs that they were comparatively long and sharply pointed as in *Tylotriton* and *Pleurodeles*. The bifid rib (Fig. 2b), which appears to be the third, is just as long as the humerus or the femur. Two of the mid-thoracic ribs are as long but the remainder are a trifle shorter. In *T. verrucosus* the third rib is only three fifths the length of the ossified part of the humerus and four fifths that of the femur. No rib of the fossil is longer than the third, although several project more laterally. The form of the rib is the same as in *T. verrucosus*, the head being constricted in the middle, but not divided into two heads as in various higher Caudata.

The pectoral girdle, although fragmentary, is sufficiently preserved to show diagnostic characters. On the left slab the greater part of the left coracoid plate is seen from above (inside), the scapula part of the same element being found on the right slab. The right coraco-scapula is much more fragmentary, but its outline is well indicated by an impression (Fig. 2c). Both coraco-scapulas agree with those of *T. verrucosus* in being well ossified, the coracoid element extending as an ossification farther from the glenoid than in most salamanders. In *T. verrucosus* the greatest width of the coracoid in the antero-posterior axis is about half the length of the humerus, while in the fossil described here it is two thirds the same length. Thus, in coracoid as in skull, *T. primigenius* is more bony than *T. verrucosus*. In outline the coraco-scapula of the first differs from that of the second (Fig. 3b), but this may be due partly to the fragmentary character of the first.

The limb bones of the fossil are for the most part stouter than those of *T. verrucosus*, but as these elements have been fully described in only a few salamanders, it is doubtful if the differences have any systematic value. The following characters distinguish the fossil from *T. verrucosus*: head of femur a bony condyle not cartilaginous as in the latter species; lateral (=deltoid) crest of humerus (left) pronounced (Fig. 2d), but not forming a high, sharp ridge as in the latter; fibula with a broad proximal head more than half again as wide as the middle of the shaft instead of being about the same width. The feet and part of the limb bones are missing in the fossil.

MEASUREMENTS

(1) Length of skull in median axis.....	20.5 mm.
(2) Greatest width of skull.....	27. mm.
(3) Greatest length of third rib.....	13.5 mm.
(4) Greatest width of third rib.....	3.5 mm.
(5) Greatest length of left coracoid in long axis of body.....	12. mm.
(6) Length of left humerus.....	14.5 mm.
(7) Greatest width of humerus across deltoid crest.....	3.5 mm.
(8) Length of femur.....	14.5 mm.
(9) Length of fibula.....	9.5 mm.
(10) Width of fibula.....	3.5 mm.

NOTES ON PARATYPES.—The partly articulated skeleton, although poorly preserved, shows clearly the fronto-squamosal arches (Fig. 4a), the broad triangular head, the long, pointed ribs, and the bifid third rib of *Tylotriton*, thus confirming

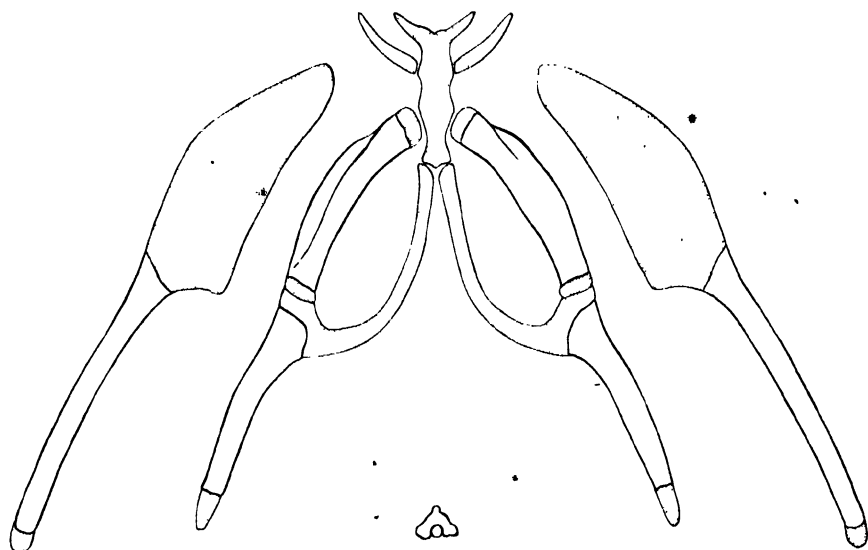
the generic identification of the type. The most important feature of this skeleton is the skull which I have compared with that of *T. verrucosus* (Fig. 4b). It is difficult to distinguish the sutures in this specimen, but it is clear that the skull was covered with rugose bone which completely covered the squamosal region (Fig. 4a). The limbs are incomplete in this specimen, but some of the phalanges, three carpal and apparently two tarsal elements are present. These are bony and as poorly preserved as the rest of the skeleton. The specimen measures 101 mm. from tip of snout to middle of the acetabulum. The skull is 24 mm. long, and 33 mm. wide. The longest rib measures 16.5 mm. in length.

The other paratype (Brit. Mus. 42761) is badly crushed and fragmentary, but the bone is not decayed. The surface texture of the secondary bone covering the quadrate and nasal regions is well shown. The left pterygoid is exposed and when compared from the same dorsal aspect with that of *T. verrucosus* is found to be much broader. The right lower jaw extends beyond the premaxillary slightly exposing a row of very small dentary teeth as in *Tylotriton*. In size and proportions this skull agrees closely with that of the other paratype.

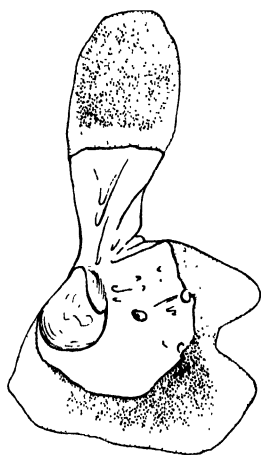
DISCUSSION.—The discovery of *Tylotriton* in the Eningen beds with *Megalobatrachus* adds another oriental genus to the Miocene fauna of southern Europe. *Megalobatrachus* and *Tylotriton*, now restricted to southeastern Asia and certain adjacent islands, must formerly have had an extensive distribution in western Europe. *Tylotriton* is a primitive salamandrid and may well represent the ancestral type from which the European newts evolved (Noble, 1927).

If *Tylotriton* was well established in western Europe during the Miocene it seems strange that the genus was not previously recorded. Further work may show that a number of the fossils already recorded under other names may be referable actually to *Tylotriton*. Thus, long ago von Meyer (1860) in describing *Salamandra laticeps* noted the long ribs and the pointed uncinatè processes in the specimen before him and discussed the possibility of the latter perforating the skin in the way the rib points do in *Pleurodeles*. There is nothing in von Meyer's description or figure which shows that his specimen is definitely a *Salamandra*, while, on the other hand, the large, triangular head and the long uncinatè processes on the anterior ribs suggest that the species is actually referable to *Tylotriton*. Further, von Meyer figures (Fig. 2) but does not discuss some bone fragments on skull and vertebræ which have the appearance of encrustations. If my interpretation of von Meyer's figure is correct his species is not a *Salamandra* but in all probability a *Tylotriton*.

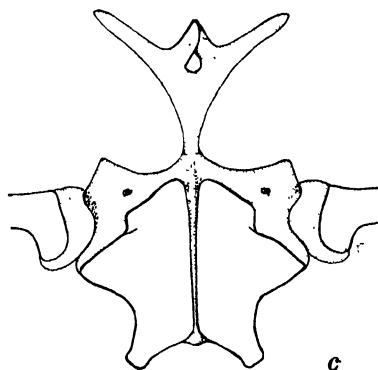
Of the many fragmentary salamandrid skeletons described from the Tertiary of Europe, only one other, to judge from the published descriptions, seems very probably referable to *Tylotriton*. Sampilayo and



a

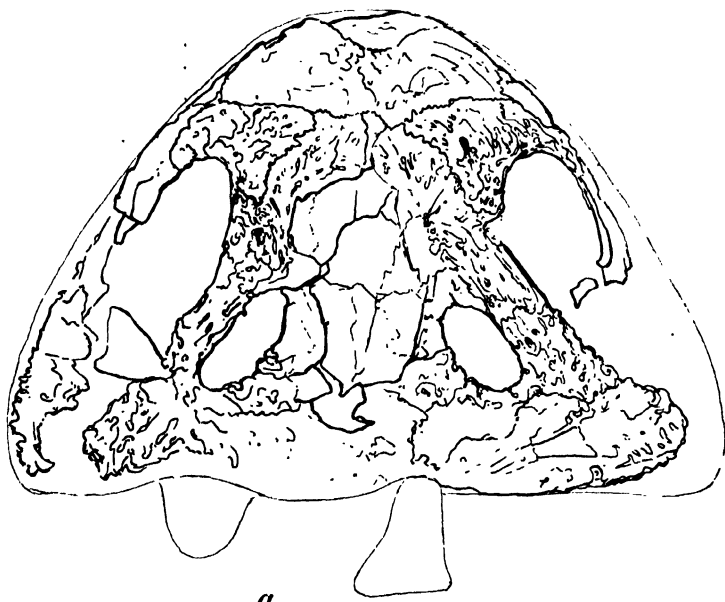


b

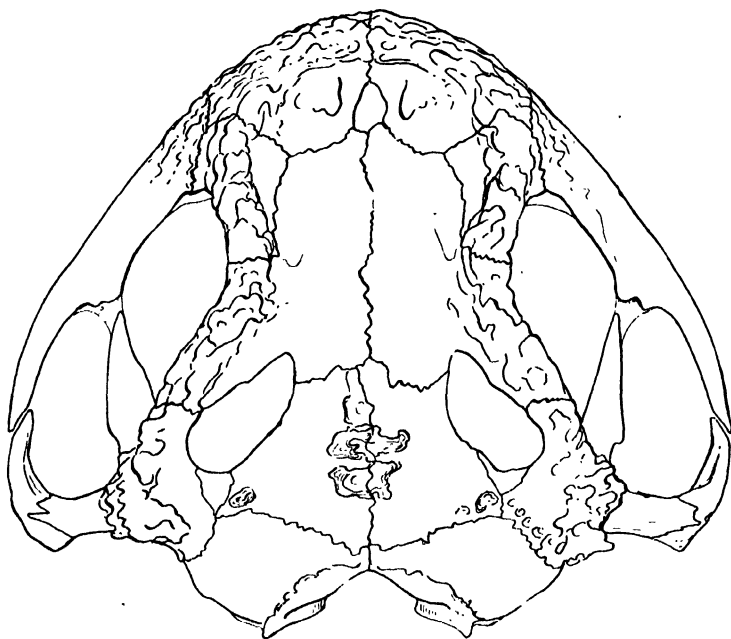


c

Fig. 3. *Tylototriton verrucosus* Anderson.
 (a) , Hyoid apparatus.
 (b) Right coraco-scapula, outer aspect.
 (c) Pelvic girdle, ventral aspect.



a



b

Fig. 4. Skull of *Tylotriton primigenius*, new species (a), and *T. verrucosus* Anderson (b), compared from the dorsal aspect. The first figure (a) is made from a paratype in the British Museum.

Cineúnegui have figured (1926, Fig. 63), but not identified or named, a urodele of about the same size and shape as *T. primigenius*. No details of the skull can be recognized from the figure, but the third rib is bifid and similar in shape to that of *T. primigenius*. Further, all ribs are long, curved and pointed. This unnamed salamander comes from the Oligocene of Spain (Ribesalbes formation).

These data tend to show that large salamandrids either identical or closely related to *Tylotriton* were widely spread in Europe during the Oligocene and Miocene. It seems probable that *Heliarchon furcillatus* von Meyer (1863) was the larva of one of these salamandrids, although the uncinat processes are longer than in any recent larval form.

It may be noted in passing that the only extensive account of the skeleton of *Tylotriton verrucosus*, that by Riese (1891), is not wholly accurate. My specimen of *Tylotriton verrucosus* differs from his description and figure of the skeleton of the same species in several particulars. I figure (Fig. 3) the hyoid, pectoral and pelvic girdle for comparison with his figures. An os thyroideum is present in *T. verrucosus*. The basihyal, ypsiloid apparatus, and procoracoid cartilage have a form different from his figures.

DISTRIBUTIONAL REMARKS.—Given *Tylotriton* in the Miocene of Europe it becomes unnecessary to postulate the western migrations of salamandrids, such as Boulenger (1917) has done. *Tylotriton* is primitive in the complete fronto-squamosal arch, the pterygoid in contact (or nearly so) with maxilla and the latter reaching the quadrate. The four-pronged basihyal, the long pointed ribs with long uncinat processes, and the extensive, well-ossified coracoid are also primitive features. The primitive salamandrid stock of Europe was probably rough-skinned as in *Tylotriton*, and the casque of secondary bone covering their skulls aided them in their terrestrial wanderings. From such an aggressive semi-aquatic type wide-spread in Europe, the present European newts may have been evolved by local adaptation to various ecological niches. Just as various genera of hynobiids have evolved from *Hynobius* by isolation on various mountain masses (Dunn, 1923), so we may conceive that the various mountain salamandrids of Eurasia were evolved from a *Tylotriton*-like stock. *Rhithrotriton* of the mountains of Kurdistan has the maxilla reaching the quadrate as in *Tylotriton*, but the fronto-squamosal arch is partly ligamentous (Boulenger, 1917). In *Euproctus asper* of the Pyrenees, the maxilla is reduced, while in *E. montanus* of Corsica both it and the fronto-squamosal arch are ligamentous (*loc. cit.*). The more aquatic newts have evolved by geo-

graphical isolation, and the different groups seem to have independently reduced the maxilla and pterygoid and lost or weakened the fronto-squamosal arch. The forms living today on the periphery of this original Eurasian range are in some ways more primitive than the species in the center of the area. *Pleurodeles waltl* is primitive in its long ribs, its hyoid and fronto-squamosal arch but both its maxillæ and pterygoids are reduced. The closely related *P. poireti*, however, may have more extensive maxillaries according to Boulenger (1917). *Pachytriton* is a thoroughly aquatic eastern derivative of the primitive stock. It has retained a broad pterygoid maxillary contact but greatly reduced the posterior ramus of the maxillaries. Further, its ribs and hyoid have also undergone a reduction.

Tylotriton lives today only in the eastern Himalayas, Yunnan, and the Riu Kiu Islands. But its occurrence in the Miocene of Europe shows that this stock was wide-spread in former times. It is from this stock that all other genera and subgenera of salamandrids, save *Salamandra* and *Chioglossa*, seem to have been directly or indirectly evolved.

Hylidæ

Hyla europæa, new species

TYPE.—Brit. Mus. No. 30267, the impression of a skeleton with some bone fragments adhering.

HORIZON AND LOCALITY.—Lower Miocene, Rott, near Bonn.

DIAGNOSIS.—Hylid characters: arciferal, sacrum single with greatly dilated sacral diapophyses, double condyle to coccyx, teeth in upper jaw, scapula nearly as long as procoracoid, tibiale and fibulare free, terminal phalanges claw-shaped, an intercalary present. Differs from *Hyla arborea* in larger size, more dilated sacral diapophyses and in slightly different proportions of the limb segments.

DESCRIPTION OF TYPE SPECIMEN.—The form and character of the fossil is shown in figure 5 which fails to clearly show the bone fragments adhering to the impression. The latter was made by the ventral surface of the skeleton. The greater part of the right clavicle is in place, only a small section near the midline being absent. This clavicle is strongly curved and directed forward. A proximal and a distal piece of the left clavicle are in place; these agree with homologous parts of the right. The coracoids and scapulas are represented by impressions to which a few very small pieces of bone adhere. The entire outline of neither scapula is clearly shown. Further, the glenoid cavity of the left scapula seems to be largely crushed, for the dorsal margins of both glenoids are visible as a pit on either side. That on the left side is much nearer the adjacent coracoid than the pit on the right side is near its coracoid. Each pit is about the same distance from the top of the scapula (outer edge of impression) of its own side. This distance is about two thirds the length of the clavicle measured in a straight line (while in *H. dominicensis* the same part of the scapula is three fourths the length of the clavicle). The pelvis is represented by an impression and a few bone fragments.

The ilium agrees in form with that of *H. dominicensis*, but may have been stouter. The sacrum was formed by a single vertebra, and the diapophyses were obviously dilated, as the impression of the left diapophysis is definite, except distally. The impression of the right diapophysis is not clear, but the caudal edge can be distinguished. Only scraps of the vertebræ remain in place, but these and the impressions show definitely that the column was procelous. The posterior edge of the centra of the four vertebræ immediately preceding the sacrum is well shown. The sacrum shows a distinct impression of two condyles. The coccyx impression is without evidence of diapophyses. The diapophyses of three presacral vertebræ show as poor impressions, but it is clear that these structures were directed slightly forward. Only fragments of the skull are present, the largest piece being the middle section of the parasphenoid, which is long and narrow indicating a dagger-shaped bone. The impression of the jaws is clear. The sockets of eight teeth in the right maxilla and seven in the left are visible. The more conspicuous of these are outlined with white in the photograph. The fragments of the pterygoid, prevomers and prootic adhering to the skull impression have the same relative position as in *H. dominicensis*, but no diagnostic details can be recognized. More or less of the four limbs are indicated by impressions and bone fragments, except the left foot which is absent. The metacarpal of the second finger (left hand) is about two thirds the length of the radio-ulna which is approximately as long as the second finger. The first finger appears to be nearly as long as the second, but this may be due to a displacement, such as the impression of the proximal end vaguely suggests. The impression of the second digit of the left hand is clear-cut for its entire length. The terminal phalanx is claw-shaped (Fig. 6), and a distinct intercalary cartilage or bone is clearly indicated. The terminal phalanx of the first (inner) finger is barely indicated but under the higher binocular powers it seems clear that an intercalary was present (Fig. 6). No details of the other digits or the carpal elements can be made out. A small prehallux less than a third as long as the tibiale is indicated. The tibiale and fibulare are separate bones. The first is contained in the length of the tibio-fibula slightly less than two times. Tibio-fibula slightly shorter than the femur. Humerus slightly more than half as long as the femur.

DISCUSSION.—The specimen described above was doubtfully referred to *Rana meriani* by Lydekker (1890), who comments (p. 123), "Slab of lignite, showing the impression of the nearly entire skeleton of a somewhat smaller frog not improbably belonging to this species. The sacrum is not shown. The contour of the soft parts of the hind limbs is preserved." The specimen, although very fragmentary, is clearly of an arciferal type and hence cannot be a *Rana* or a ranid. In assigning the species to *Hyla*, I have made use of a number of characters, but as some of these are indicated merely by impressions, their validity may be questioned. It may, therefore, be well to point out why the fossil described here cannot be referred to any other arciferal group. It cannot be a species of *Palæobatrachus* because of its longer and narrower scapula, its shorter metacarpals (much shorter than the radio-ulna), its single sacral vertebra and greatly dilated sacral diapophyses. It cannot

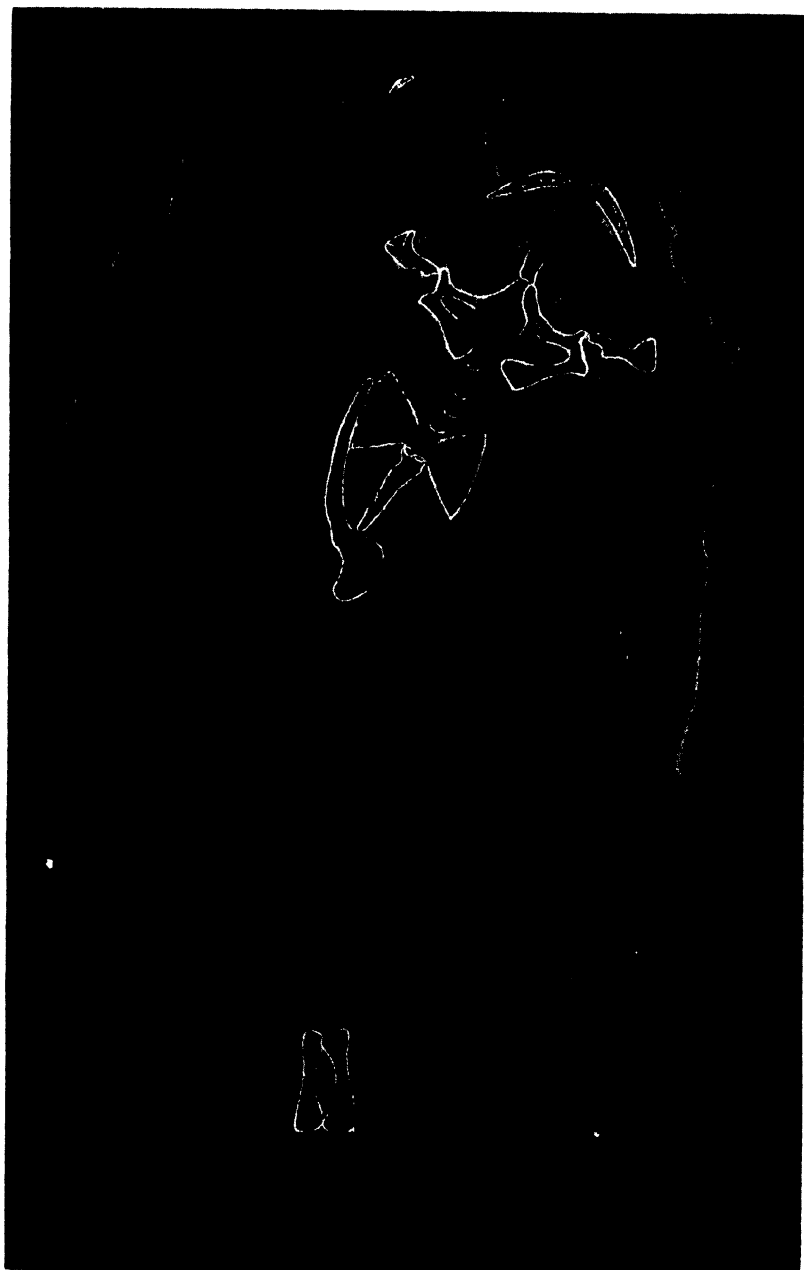


Fig. 5. *Hyla europæa*, new species, type specimen. The diagnostic structures are outlined with white.

be a discoglossid because of its definitely procœlous vertebræ, and its longer and narrower scapula. The species has some characters in common with the pelobatids, but there is a definite double condyle to the coccyx and, although the tibiale and fibulare are free, there is no suggestion of osteoderms as in *Pelobates*, etc. If we should assume that the impressions of claw-shaped phalanges and intercalaries are both illusions,

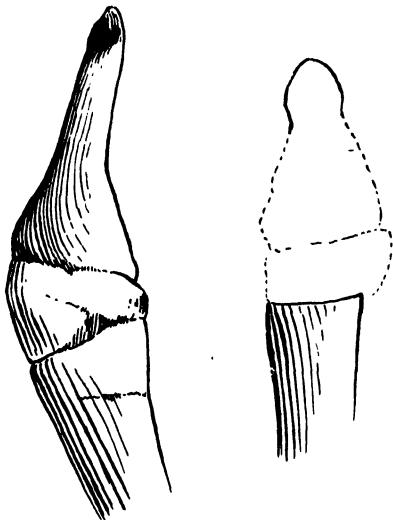


Fig. 6. *Hyla europæa*, new species. Impression of the terminal phalanges of the first and second digits of the left hand. Type specimen. The second digit is on the left.

then the species can be only a highly aberrant, toothed bufonid. As I have indicated in Fig. 6, the impression of these elements on the second finger of the left hand is perfectly clear and I do not hesitate to refer the species to *Hyla*.

Hyla europæa differs from the present tree frog of Europe, *H. arborea*, in its larger size, more dilated sacral diapophyses and slightly different limb proportions.

DISTRIBUTIONAL REMARKS.—The discovery of a tree frog in the Miocene of Europe lends considerable support to the view previously advocated (Noble, 1925) that the genus arose in the north and spread southward to its present range. Frogs and toads make few and poor fossils. In discussing the dispersal of the group, considerable allowance must be made for the scantiness of the fossil record. It is well known that a host of

mammals living in the Miocene of Europe have spread since that time to Africa, southern Asia, and some even to South America. Where the fossil record is full, as in the case of the mammals, the actual migration of such forms may be traced with some degree of confidence. The fossil described above proves that tree frogs were in Europe during the Miocene with tragulids, rhinoceros and other groups found today in Africa. Whether or not tree frogs followed the migration routes of these mammals and later died out along most of the route is unknown. But, I believe that extinctions have occurred far more often than some zoögeographers, such as Metcalf (1923), have assumed. In brief, the absence of a fossil record in the Salientia proves nothing, while the presence of even a single record may be of the greatest importance in determining the routes of dispersal.

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ENZYMES AND BACTERIA IN THE HONEY BEE

By F. MARTIN BROWN

While reviewing the literature of the physiology of the digestive system of the honey bee (*Apis mellifera*) my attention was attracted to the varying results in the studies of the enzymes entailed in digestion. For an instance, Petersen (1912) lists three: diastase, invertase, and a proteolytic enzyme. Pavlovsky and Zarin (1922) list nine: catalase, inulase, lactase, invertase, lipase, pepsin, trypsin, chymosin and emulsin. Of these it is rather difficult to understand any reason for the presence of diastase, lactase, and possibly chymosin as native digestive ferments.

Diastase is an agent in the digestion of starch. In this process dextrins are formed as intermediates and they are poisonous to honey bees, being the cause of bee dysentery. Lactase reduces only lactose, a purely animal sugar found in milk, and I doubt its being a part of a bee's diet. Chymosin's rôle in digestion is to coagulate proteins, as those found in milk. It may have a doubtful claim based on the possibility of the protein in pollen needing its action, or the bare possibility of a minute quantity of protein being present in nectar and needing it. Catalase is in another category and it is very doubtful if it plays any part in digestion. Its sole purpose is to reduce the peroxides formed during metabolism and thus prevent the death of the tissue by excessive oxidation. It is present in small quantities in all living tissue. However, the presence of large quantities of this enzyme in the digestive tract will be accounted for below.

Petersen's finding of diastase may be accounted for. In animal tissues a diastase-like enzyme, glycogenase, is found for the conversion of stored animal starch, glycogen, into glucose, its utilizable form. The remaining enzymes, invertase, trypsin, lipase, etc., are necessary for the reduction of the higher sugars, as sucrose to glucose, the digestion of protein in pollen and the emulsifying and digesting of the fats in pollen. The presence of the extraneous enzymes may be explained as being produced by the bacteria so plentiful throughout the digestive system.

At the American Museum's Station for the Study of Insects, Tuxedo, New York, we examined the flora of the digestive tracts of seventy-two presumably normal healthy honey bees. Our procedure was as follows:

1.—Bees were captured arriving at and leaving the hive and killed with cyanide fumes.

2.—They were then immediately dissected in a sterile Petri dish with sterile instruments observing all precautions for preserving an uncontaminated excised digestive tract.

3.—The digestive tract was washed in sterile physiological salt solution to free it externally of body fluids and then cut in four sections—proventriculus, ventriculus, small intestine and rectum.

4.—Each of these sections was used to inoculate a tube of sterile 0.5% glucose broth.

5.—These were incubated for twenty-four hours at room temperature and then plated on three media—plain nutrient agar, 0.5% glucose agar, and eosin-methylene blue agar.

6.—These plates were then incubated four days at room temperature and the various types of colonies on each examined and tube cultures made on plain nutrient agar and, when necessary, 0.5% glucose agar.

7.—Single cell cultures of each tube were then made for identification purposes.

In all, over two hundred cultures were isolated and the diagnostic reactions of each recorded. Grouping like cultures together, we accepted as specific thirty-four strains representing four families of Eubacteria.

Coccaceæ	2
Spirillaceæ	2
Bacteriaceæ	25
Bacillaceæ	5
	—
	34

Of these, ten had been recovered by earlier investigators of the flora of bees. Distributing them according to the location from which they were isolated we find:

	Proventriculus	Ventriculus	Small Intestine	Rectum
Coccaceæ	1	2	0	0
Spirillaceæ	0	1	0	1
Bacteriaceæ	3	2	11	10
Bacillaceæ	1	3	0	1
	—	—	—	—
	5	8	11	12

The strains represent the following genera:

Coccaceæ	
<i>Streptococcus</i>	1
<i>Micrococcus</i>	1
Spirillaceæ	
<i>Spirillum</i>	1
<i>Vibrio</i>	1
Bacteriaceæ	
<i>Achromobacter</i>	3
<i>Flavobacterium</i>	2
<i>Lactobacillus</i>	1
<i>Salmonella</i>	2
<i>Eberthellia</i>	9
<i>Proteus</i>	4
<i>Esche ichia</i>	2
<i>Aerobacter</i>	2
Bacillaceæ	
<i>Bacillus</i>	5

A future paper will fully describe the various strains and compare them with named strains isolated and described by other workers in bee and general bacteriology.

The enzymes produced by these bacteria included all of those that have been listed from bee digestive tracts. . Diastase, however, was generated only in traces. It is probable that when a bee becomes infected with a diastase producer and the hydrolysis of the starch in the pollen by that bacteria produces dextrin it causes the disease called bee dysentery. No complete study of the several anaerobic strains isolated has been made, but as a group there is little difference in the enzymes produced, only one enzyme being lacking among anaerobes that is present in aerobes, that is catalase. Without its presence a bacterium cannot exist aerobically since the production of peroxide takes place in the presence of free oxygen and peroxide is detrimental to the organism (McLeod and Gordon, 1923, 1925). The fact that aerobes produce great quantities of catalase probably accounts for the presence of it in the rectum, noted by Pavlovsky and Zarin especially after the winter hibernation when all the wastes of that period have accumulated including the wastes of the bacteria.

In order to test our deductions that many enzymes reported were extraneous, we repeated the experiments of previous writers to determine the presence of digestive enzymes. The only changes made in their procedures were to make sure that little or no bacterial products were included in our materials. This was done by carefully splitting the diges-

tive tract and washing it free of its contents with sterile saline solution before grinding it up. The sterility of the triturated masses was tested by inoculating a small portion into 0.5% glucose broth. Tubes showing marked bacterial growth in twenty-four hours were considered to indicate contaminated masses. All tubes showed some growth but in most cases this was negligible. These masses gave uniform positive reactions for only three digests listed above, namely, invertase and the two proteolytic enzymes, pepsin and trypsin. Lipase was recorded doubtfully once and positive once in five tests. It is recognized that lower organisms may adapt themselves to produce enzymes to suit their food. It may be that bees do so to some degree, and, for an example, produce inulase when called upon to utilize inulin for food, although the experiments of Phillips (1924) seem to indicate to the contrary.

CONCLUSIONS

- 1.—Care must be taken in work on the enzymes of the digestive tracts of insects to exclude those produced by micro-organisms present.
- 2.—Much of the literature on the digestion of honey bees at least must be read and quoted with that fact in mind.
- 3.—Normal intracellular enzymes similar to digestive enzymes must be recognized.
- 4.—The normal native enzymes of the digestive system of honey bees are an invertase, both peptic and tryptic proteolytic enzymes, and a lipase.
- 5.—Other carbohydrases may be present under special conditions.
- 6.—One cause of bee dysentery is probably an infection of diastase producing bacteria.

I wish to acknowledge gratefully the assistance accorded me by Dr. Edward Rushmore of the Tuxedo Memorial Hospital, Tuxedo, New York, in allowing me the use of his laboratory, and by Miss Margaret Stevens, his technician, during the early stages of the work. The final bacteriological work was carried on in the laboratory of the Newport Hospital, Newport, R. I., where I was greatly assisted by Miss Hazel Heffron, the technician in charge. To a far greater degree I am indebted to Dr. Frank E. Lutz in charge of The American Museum of Natural History's Station for the Study of Insects at Tuxedo, New York, for many helpful suggestions and friendly interest during my stay at the Station.

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A NEW SPECIES OF BACTERIA AND THE GALL OF AN APHID

BY FRANK E. LUTZ AND F. MARTIN BROWN

One of the most mysterious phenomena in biology is the formation of insect-galls on (or by) plants. A common sequence of events is: a "gall-making" insect lays an egg or eggs in some definite part of a plant; that part of the plant then develops into a structure absolutely characteristic of the insect concerned but often decidedly different from anything the plant develops under any other circumstance; this new structure serves as food and protection for the young insect or insects. There are a number of complications which any theory concerning the causative factor or factors of gall formation must meet. Among them are the following.

In some cases the gall forms before the insect egg hatches; in others not until the larva starts to feed on the plant tissue. It has been said that sometimes a gall follows an egg-laying puncture even though an egg is not laid or, if laid, fails to hatch.

Certain plant-lice are associated with gall formation even though they lay no eggs on the plant but reproduce viviparously. In this case the gall has been supposed to be due to the irritation caused by the puncture of the plant tissues by the insects while feeding.

The fact that the galls, in their external appearance and internal structure, are frequently so characteristic of the insects associated with them that the galls give as satisfactory grounds for identification as the morphology of the insects themselves is well illustrated by two common "oak apples," *Amphibolips* (or *Cynips*) *confluentus* and *Amphibolips inanis*. The same part (leaf) of the same or closely related plants (oaks of the black-oak group) is affected and yet in the case of *confluentus* the whole interior of the gall surrounding the larval chamber is filled with a juicy tissue that later becomes like a mass of wool, while in the case of *inanis* the mature gall is, as its name signifies, empty except for the larval chamber held in place by radiating threads of plant tissue. Such structures are never known on oaks except in connection with this group of insects, and these insects are always associated in at least one part of their life cycle with a particular form of gall.

In this connection there is another complication. Many of the Cynipid wasps, to which family *Amphibolips* belongs, have alternating generations. In that case, one generation may be associated with one kind of a gall in one part of its host plant and the other generation with a totally different but equally characteristic kind of a gall in another part of the same host.

If it be true, as seems to be the case, that the plant-louse, *Hamamelistes spinosus*, which is associated with a complicated spiny hollow gall on the witch-hazel, has an alternate generation on another host (birch) where it is not associated with a gall, matters are, if anything, more complicated.

If one generation of a given insect is associated with a gall and the alternate generation is not, it is scarcely surprising that among closely related insects some species are "skilled gall-makers" and others are in no way connected with plant galls. At the same time, gall-insects are confined largely to one family (Cynipidæ) of Hymenoptera, one family (Itonididæ, formerly called Cecidomyiidæ) of Diptera, and one family (Aphididæ) of Homoptera. Also, although a wide variety of plants are affected, willows, oaks, the rose group, and goldenrods furnish the largest number of good examples.

There is every gradation in gall structure from such complicated things as "oak apples" and the spiny gall of the witch-hazel down to simple swellings or slight leaf-foldings. It is, therefore, impossible to say in some cases whether a malformation of the plant should be called a gall or not.

Insects are not the only organisms which, either directly or indirectly, bring about galls. Of the others, the most interesting in this connection are fungi and bacteria. Fungus galls are the more conspicuous but the bacterial root-galls of legumes, for example, are quite as definite and seem to be as truly galls.

The most accepted explanation of gall formation is that some chemical, enzyme or something of the sort, is injected by the female when she lays her egg, or by the plant-louse as it sucks, or is given off by the larva as it feeds, and that this stimulates the plant to gall formation. There is nothing to disprove this and there is even some experimental evidence in its favor. At the same time, the senior author has been wondering for some time if all plant galls, including those supposed to be directly caused by insects, are not fundamentally due to either bacteria or fungi.

It is known that the females of certain wood-boring insects carry with them from one tunnel to another spores of the fungi upon which they

feed and the same is true of fungus-growing ants. Likewise, an insect coming from a bacterial gall might carry bacteria with which she unintentionally inoculates the plants upon which she lays her eggs. With this idea in mind, he suggested to the junior author in 1926 a study of the bacteria of galls and of the associated insects. The remainder of this paper is entirely the work of Mr. Brown and, although time has not permitted a wide survey and the case is far from proved as to *spinosus*, his results are certainly interesting and the matter seems worthy of further consideration even if only from the standpoint of bacteriology.

During August and September 1926 five strains of the same bacterium were isolated from the tissues of the *Hamamelistes spinosus* gall on witch-hazel and also from the aphids themselves. Two of these were from inoculations on agar made by Dr. F. E. Lutz at the American Museum's Station for the Study of Insects near Tuxedo, N. Y., two were made by F. M. Brown at the same place, and one by F. M. Brown at Newport, R. I. These repeated appearances of the same organism both in the "gall-former" and the gall tissue at different times and in different localities leads us to believe that the organism may be associated with the formation of the gall. Experimental inoculation of witch-hazel leaf-buds by F. E. Lutz and F. M. Brown during the winter, spring, summer and early autumn of 1927 with saline suspensions of the bacteria, broth cultures, and smears of agar growth were in each case negative. The non-success, however, may be due to the loss of virulence of the organism when grown on artificial media, as occurs in many cases. This may or may not be remedied by a passage through the aphid before inoculation in order to restore the strength of the culture.

The *spinosus* organism is a member of the Bacteriaceæ and probably referable to the genus *Erwinia*. A description follows.

***Erwinia espinosa*, new species. (F. M. Brown)**

Soc. Amer. Bact. Index No. 5312-32120-1111.

Rods small and variable in size, 0.2-0.3 by 0.5-0.9 micron. Sluggishly motile except in very young cultures, then quite active. Gram negative.

GELATINE COLONIES.—Punctate, transparent.

GELATINE STAB.—Slow stratiform liquefaction; considerable flocculent growth at bottom of well.

AGAR COLONIES.—Circular, smooth, dirty white; glistening surface.

BROTH.—Turbid, some flocculent sediment; one strain, *R* tended to form a slight fragile pellicle.

LITMUS MILK.—Acid, coagulation, some gas, some reduction in one Strain *Y* after 20 days of growth.

POTATO.—Dry, cream-color to pale yellow, surface bubbled (due to fermentation of dextrose from hydrolysis of starch).

INDOL is formed.

NITRATES are reduced.

SULPHATES are not reduced.

H₂S is formed in varying amounts from none to heavy trace.

CARBOHYDRATES are freely attacked; acid and gas are formed in arabinose, dextrose, lactose, xlyose, levulose, galactose, sucrose; the per cent of gases varies slightly with the strain. No action on rhamnose or pectin. Acid is formed from inulin and with one strain, "Y," gas.

STARCH is hydrolyzed.

Aerobic, some facultative ability.

Optimum temperature 25°C–30° C.

Bergey, D. H., *et al.*, 1925, 'Manual of Determinative Bacteriology' was used for all bacterial terminology.

59.79 (75.6)

SOME PLETHODONTID SALAMANDERS FROM NORTH
CAROLINA AND KENTUCKY WITH THE
DESCRIPTION OF A NEW RACE OF
LEUROGNATHUS

BY CLIFFORD H. POPE

This paper is a record of field studies made in western North Carolina and extreme southeastern Kentucky from June sixteenth through July twenty-eighth, 1927. It deals especially with *Plethodon shermani*, *P. jordani*, *P. metcalfi*, and *P. glutinosus*; *Aneides æneus*; *Leurognathus marmorata intermedia*, a new subspecies; and a local Kentucky form of *Desmognathus fuscus fuscus*. Brief mention is also made of *Desmognathus fuscus carolinensis*, *D. quadra-maculatus* and *D. phoca*; *Gyrinophilus danielsi*; and *Eurycea bislineata wilderæ*.

The main objects of this field trip were to work out the relationships of the four species of *Plethodon*—*P. glutinosus*, *P. shermani*, *P. jordani*, and *P. metcalfi*—and to find out the affinities of *Aneides æneus* as shown by its life-history. Material that will help determine the status of Dunn's newly described *Desmognathus fuscus imitator* was also secured and a race of *Leurognathus marmorata* discovered.

Highlands is a town in western North Carolina just north of the northeastern corner of Georgia. It is in the Blue Ridge at an altitude of about 3800 feet.

Wayah Bald, the highest peak in the Nantahala Range, reaches an altitude of 5200 feet or more. It is in Macon County, western North Carolina, nine miles west of Franklin.

Waynesville, in the Balsam Mountains of Haywood County, western North Carolina, is just 2638 feet above the sea.

Davis Gap, a pass at an altitude of 3200 feet, is three miles west and a little south of Waynesville. Pigeon Road runs through this Gap.

Andrews Bald, one of the most accessible of the higher peaks of the Great Smoky Mountains, reaches an altitude of 5900 feet and is located in Swain County, eight miles north and a little west of Bryson City. The Tennessee-North Carolina boundary line follows, for some distance, the highest ridge of these mountains.

Pine Mountain Settlement School, Harlan County, southeastern Kentucky, is located on the northern base of Pine Mountain at the head of Greasy Creek. The Bench Mark on the School grounds is at 1756 feet

altitude, while the ridge above maintains for many miles a uniform altitude of 2750 feet.

I wish to thank Mrs. Ethel de Long Zande and her colleagues of the Pine Mountains Settlement School, for giving me a place to stay and making me feel very much at home while collecting *Aneides æneus*.

The trip was made possible by a grant from the Douglas Burden Research Fund of The American Museum of Natural History.

***Plethodon glutinosus* (Green)**

On the mountains about Highlands at an altitude of from 3600 to 4400 feet this salamander was found closely associated with *P. metcalfi* though it was not so common as that species (A. M. N. H. Nos. 25251-3). In the valleys at the base of Wayah Bald, 2300-3000 feet in altitude, *P. glutinosus* was not abundant (A. M. N. H. Nos. 25260-7), nor was it very readily found in Mill Creek Valley near the foot of Andrews Bald at similar altitudes (A. M. N. H. Nos. 25435-8). On the west slope of Pine Mountain *P. glutinosus* was abundant. It lived in greatest numbers under the loose rocks embedded in the débris forming the forest floor.

The following table gives the summary of measurements in millimeters of the fifteen largest specimens of each sex among a series of ninety-five *glutinosus* collected at various places in North Carolina by Dunn, 1916, and by myself, 1927.

	Longest Body	Average Body Length	Longest Head	Average Head Length	Widest Head	Average Head Width
MALES	60	52.1	16.3	14.8	11.5	10.1
FEMALES	65	56.9	16.5	15.1	12	10.5

Among the males there are only four tails more than 70 mm. long while the tails of seven females exceed this length. Sexual dimorphism is marked in this species.

***Plethodon jordani* Blatchley**

Working alone July 14 on Flat Top, I collected in an hour's time thirty-five examples of this species (A. M. N. H. Nos. 25455-25489). Flat Top is a sparsely wooded, flat, grassy area slightly above 5000 feet in altitude near the top of Andrews Bald. On the following day, working in the same area with the help of a local man, I secured seventy-eight specimens in about four hours. Among these are A. M. N. H. Nos. 25490-25531 and 25581. These figures give a good idea of the abundance of this species there. The specimens were found in the rather open woods inside of and under rotten logs, under sticks and pieces of bark of all sizes,

and beneath solid logs. They were most frequently found just beneath the loose bark of prostrate sticks and logs. They are active but easily picked up. I found none under stones.

This was the only *Plethodon* taken at any great altitude on Andrews Bald. *P. glutinosus* seemed to be confined to the lower valleys and even there it did not occur in abundance. No specimens of *metcalfi* were found in this region.

In this new series of seventy-eight individuals the red on the cheeks varies in shade and amount. Though usually a bright coral hue it is sometimes a much duller red and may even approach yellow. Approximately one-fourth of the series had the full complement of color on both cheeks, about one-tenth had only a trace, while only two (A. M. N. H. Nos. 25490 and 25581) lacked the color entirely. On the remainder, slightly more than six-tenths of the whole, the red is present in varying quantities, always more than a mere trace, but never the full complement. Three of thirty-seven *P. jordani* collected on Mt. Sterling (Dunn, 1920) lacked the red stripe, while one of the three had red spots on the legs. I fail to find any among the new series with the latter coloration.

About three dozen specimens were shipped alive to the Museum. They have not been examined. If anything they would average high in amount of red on the cheek since they were picked out in the field with this character in mind. I do not detect any correlation between the red cheeks and sex.

The following table gives a summary of the measurements in millimeters of twenty of the larger examples, ten of each sex.

	Longest Body	Average Body Length	Longest Head	Average Head Length	Widest Head	Average Head Width
MALES	42	39.6	13	11.9	8	7.5
FEMALES	45	41.1	12.5	11.8	9	7.9

A comparison of the tail length is difficult because the tails of four females are incomplete, while that of only one male is damaged. In both sexes the longest tail is 60 mm. There is probably little difference in their averages.

Nos. 25497 and 25498, the smallest of the lot, measure respectively 17 and 16 mm. in body length.

It should be noted that in this species the male is only slightly smaller than the female. Mature males have a conspicuous mental gland.

***Plethodon metcalfi* Brimley**

This is the common *Plethodon* about Highlands. I caught one three feet above ground among dry sticks of wood piled under shelter. Another was found five feet above the ground in a pile of uncovered wood. Local inhabitants say that specimens are often seen thus in wood piles. *P. metcalfi* are sometimes found under small stones in dry, open woods. I collected them in the vicinity of Highlands from 3600 to 4300 feet above the sea.

The following table gives the summary of the measurements in millimeters of the fifteen largest specimens of each sex among a series of 121 *metcalfi* collected at various places in North Carolina by Dunn in 1916.

	Longest Body	Average Body Length	Longest Head	Average Head Length	Widest Head	Average Head Width
MALES	41	38.1	12.5	11.5	8	7.4
FEMALES	47.5	42.8	13	11.9	9	8.1

Only two males have a tail more than 50 mm. long while this length is exceeded by the tails of seven females. The females of this species are decidedly larger than the males.

***Plethodon shermani* Stejneger**

During a four-hour hunt in damp woods around a meadow near the top of Wayah Bald, at an altitude of about 5000 feet, I secured alone on June 28 thirty-five examples of *P. shermani* (A. M. N. H. Nos. 25272-25305 and 25307). Many were taken inside of and under rotten logs, under sticks and bark, and beneath solid logs. Their favorite place of concealment was under the loose bark of prostrate sticks and logs. On June 22, twelve more specimens were secured, among them A. M. N. H. Nos. 25308-25313. The following day I found, without help, thirty more, among which are A. M. N. H. Nos. 25314-25331. These figures give some indication of their abundance. None were seen lower than 4000 feet and it was only in the damper sections of the higher woods that they were so abundant. They prefer woods along streams though they are also found far from the latter. They are active but readily picked up. I saw none under stones.

No other *Plethodons* were found above 4000 feet on Wayah Bald. *P. glutinosus* was common, though not abundant, in the valleys at the base of the mountain. No specimens of *P. metcalfi* were found in this region.

In the series of fifty-seven individuals at hand the red on the legs varies greatly in shade and amount. It is usually a bright coral hue. Approximately one-third of the series has the full complement of color on all four legs, about one-fifteenth has only a trace, while in the remaining three-fifths the red is present in varying quantities, always more than a trace, but never the full complement. There is generally more red on the arms than the legs, while on all four limbs the red is more constant on the proximal than the distal sections.

About two dozen specimens were shipped alive to the Museum. They have not been examined. They would probably average high in amount of red on the legs since they were selected with this character in mind. I fail to detect any correlation between the red cheeks and sex.

The following table gives the summary of the measurements in millimeters of twenty-four of the larger specimens, twelve of each sex.

	Longest Body	Average Body Length	Longest Head	Average Head Length	Widest Head	Average Head Width
111 MALES	51	45.1	14.3	13.2	9	8.5
11 FEMALES	51	45.6	14.	13.1	10	8.3

In both sex series there are six tails more than 50 mm. long but the two longest tails, 75 and 61 mm. respectively, belong to females.

In this species there is almost no difference in size between the sexes. Mature males have a conspicuous mental gland.

The three smallest in the series measure 13, 13 and 12.5 mm. respectively in body length.

***Gyrinophilus danielsi* (Blatchley)**

One adult (A. M. N. H. No. 25270) was taken about 5000 feet above the sea near the top of Wayah Bald under rocks lying in a spring stream.

***Eurycea bislineata wilderae* Dunn**

One of these salamanders (A. M. N. H. No. 25271) was found on June 21 under a big decaying log with heaps of dead leaves piled along its side. The log lay approximately 5000 feet above the sea near the top of Wayah Bald mountain. *P. shermani* were abundant in the same woods but only the one *Eurycea* was seen. On Flat Top, which is a level space near the summit of Andrews Bald, six more examples (A. M. N. H. Nos. 25439-25442 and 25532-3) were taken June 14 and 15 along with numerous *P. jordani* under logs and other debris lying about 5200 feet above sea-level on the floor of the open, grassy forest there.

Aneides æneus (Cope and Packard)

On July 20th through the 25th, and again on the 28th I hunted this salamander in the vicinity of Pine Mountain Settlement School with Evans Compton, a thirteen-year-old student who acted as guide and assistant collector. Since so little is known of the habits of *Aneides æneus*, I do not spare detail in the following record of our work which I give in diary form.

July 20. We hunted for part of the afternoon on the School grounds just below the reservoir in damp, thick woods and found one specimen inside of a large, decayed log.

July 21. During the morning we hunted in the forest along the Laden Trail, a wagon road that crosses Pine Mountain about a mile southwest of the School, and found five specimens (A. M. N. H. Nos. 25583-25587) as follows:

- (a) a small one under the very loose bark of a solid log lying beside the road.
Only a little bark remained on the log;
- (b) two small ones under the bark of a limb of a large, prostrate water oak. The log was solid and the specimens were about five feet above the ground;
- (c) one more under the very loose bark of a large, prostrate, solid, chestnut log lying by the road;
- (d) the fifth under the bark of a large, solid, prostrate log embedded in a thicket above the road.

A long hunt in the afternoon, along the base of Pine Mountain about a mile northeast of the School, netted only one specimen. It was taken on the edge of a clump of scrub trees under the bark of a solid section of a log lying in a dry, overgrown pasture. The log was exposed to the sun.

July 22. Our morning's search was fruitless but in the afternoon we found one specimen a mile below the School near Greasy Creek under the bark of a section of a solid water oak lying exposed to the sun in an area devastated by lumbermen and another (A. M. N. H. No. 25589) under the remaining loose bark of a solid, prostrate log also well exposed and lying in the same devastated area.

July 23. Hunting in the forest near the base of Pine Mountain about two miles southwest of the School we found four specimens (A. M. N. H. Nos. 25590-25593), the first two under the loose, decaying bark on the upper side of a huge, prostrate, chestnut log and the last under the loose bark of another fallen chestnut tree four or five feet in diameter and not far from the first. Both logs were solid.

The third specimen was found with a batch of fourteen eggs in a prostrate water-oak limb eight feet long and one foot in diameter. The eggs were in a long, shallow cavity one to three inches wide by one deep and near one end of the limb. Much of the bark was missing and the log, though still solid, had a thin layer of decayed wood under the bark where the eggs were found. The cavity was on the side of the log and so the eggs, though virtually suspended, actually rested against the cavity's bottom or the side of the log.

The eggs formed an irregular cluster, adhering closely one against the other, but held by four short mucous cables against the side of the cavity. The main one of these cables was two or three millimeters in diameter while the other three were less than half that size and irregularly arranged and connected. The eggs were not otherwise connected with the wood. In color they were a dirt-brown with a tinge of yellow, but much of the color may have been due to stain from the decayed wood. The egg capsules were probably colorless at first. The outermost capsule of each egg is about five millimeters in diameter. I could detect no sign of arranging or smoothing done in the cavity by the adult. Unfortunately, the eggs were not noticed until the adult had been secured in a vial with one other and therefore I cannot be sure of the sex. One of the two was a male (A. N. M. H. No. 25591) and the other a female (A. M. N. H. No. 25590). Probably it was the female that guarded the eggs.

A. lugubris attaches each egg by a separate cable to the wall of the containing cavity (Ritter and Miller, 1899 and Ritter, 1903). We must conclude that *A. xneus* differs in having its eggs directly adherent one to the other, the entire mass being attached to the cavity's wall by one or more short cables.

July 24. During a long half-day's search we found only one specimen (A. M. N. H. No. 25594). It was taken in the forest near the base of Pine Mountain some two miles southwest of the School under the very loose, decaying bark of a chestnut limb or small tree barely a foot in diameter leaning against other trees. The salamander was about five feet above the forest floor.

July 25. It was not until this date that we really found the true habitat of *A. xneus*. On this day our first three hours netted twelve specimens and yet we hunted just where we had worked before with little result. Searching in the forest along the Laden Trail we found:

- (a) one at the base of Pine Mountain under the very loose bark of a solid chestnut stump five feet high and ten inches in diameter;
- (b) six or seven more not far away under the very loose bark of a solid white walnut limb some twelve feet long and eight inches in diameter lying near a stream in heavy shade with one end propped against small trees and the other resting on the ground;
- (c) two more only twenty feet away on a solid, poplar log placed much as the white walnut just described;
- (d) two more under the bark of the end branches of a large, solid, basswood log lying in a tangle of weeds and bushes about halfway up Pine Mountain, three to four feet above the forest floor;
- (e) two more under the bark of a large, solid chestnut limb lying across a fallen tree; and finally,
- (f) four more under the bark of a large, solid, maple log lying near the road about halfway up the mountain.

July 28. In about an hour's hunting alone in the woods between the School and the reservoir I found five specimens:

- (a) two of which were under the loose bark of a slender, solid, chestnut log leaning against some living trees;
- (b) one more three feet from the ground under the loose bark of a small, solid stump about four feet high; and finally,

- (c) two more, one large and one small, four to five feet from the ground under the loose bark of an upright, dead, white walnut tree still quite solid and only four to six inches in diameter.

Aneides æneus, then, lives under the loose bark of dead trees. Unfortunately, only the popular names of the trees on which my series were taken can be given, though these may be relied upon because they were verified by an advanced student of the Settlement School.

12 examples were living on chestnut
8 or 9 examples were living on white walnut
5 examples were living on water oak
4 examples were living on maple
2 examples were living on poplar
2 examples were living on basswood
1 example was living on pine
1 example was living in a decayed log

Three additional specimens were found on logs which I failed to identify. The names of at least two of these undetermined logs would be included in the above list. The great numbers of fallen chestnuts on Pine Mountain may account for their heading the list. It would seem that *Aneides æneus* shows little preference for the kind of tree but cares very much about the nature of and the condition the bark happens to be in. Bark that, in becoming loose, leaves a continuous cavity beneath, is preferred. In size the logs varied so much that I do not regard size as a significant factor. Twenty-three specimens were seen on prostrate logs and limbs, twelve or thirteen on logs and limbs not upright but supported at various angles, while only four were found on dead trees and stumps standing erect. These figures are misleading because at first we searched almost entirely on fallen logs. My later hunts convinced me that dead trees yet standing are frequently inhabited. That it does not live in or under moss is evident because from the first we scraped moss from dead trees and yet not one did we find in or near moss. Countless rotten logs were broken up but only one specimen, and that one the very first, was found in soft, decayed wood. All the rest were taken on solid logs and limbs. Our examples, for the most part, were found at altitudes ranging from 1700 to 2000 feet. I failed to detect any preference for damp localities, for *æneus* was as abundant in the dry as well as the damp parts of the forests. None was taken more than six feet from the ground. Even though I often peeled bark much higher than this, I made no effort to search among the branches of the larger, upright trees.

When uncovered this species is easily captured for it is slow and deliberate in its movements. As a rule it does not try to escape at once

but remains motionless until further annoyed. It is readily coaxed into bottle or vial. In the laboratory it walks up a perpendicular surface of glass with ease. If motionless, it will remain on the under side of dry glass but cannot walk for more than a few steps without falling off. This shows what a good climber it is. Wherever there is an irregular surface, such as that of rough bark, *A. xneus* can hang from it even with one foot, thanks to the effective terminal expansions on its toes. Though not truly prehensile, the tail may delay or check a fall. It seemed to be unable to

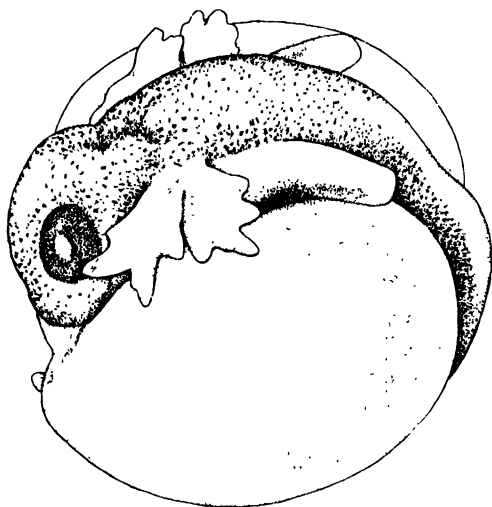


Fig. 1. Encapsulated larva of *Aneides xneus* showing form of gill.

remain suspended by the tail though the latter is often turned about a limb or twig. In the laboratory *A. lugubris* showed more inclination than *A. xneus* to use the tail as a support. When annoyed *xneus* sometimes progresses by a series of short, quick jumps. Otherwise it walks deliberately.

This species is mottled dorsally with very dark but uniform purplish chocolate and stippled green or yellow-green, the yellow being more in evidence on the tail and the region of the limbs next to the body. The yellow is often faint and may even be lacking all together. The ventral surface is uniformly light.

Dunn's (1925) descriptions were made from preserved specimens in which the originally conspicuous green must have long since disappeared.

Measurements (in millimeters) of a series follow:

MALES

A. M. N. H. No.	Length of Body	Length of Head	Width of Head	Length of Tail
25583	36.5	12	8.	50
25584	38	14	9	56
25585	32	11.5	7.5	50
25591	43	15	10.	53
25593	34	12.5	8.	29
25594	37	14	9.	67
25602	33.5	12	7.3	47
25604	35	12	7.	50
Averages	36.1	12.9	8.2	—

FEMALES

25590	47	15	9	60
25592	34	12	7.5	32

The smallest specimen, A. M. N. H. No. 25589, has a body only 17 mm. long. Judging from measurements given by Dunn (1925), *æneus* is the smallest species of the genus.

The gills were just appearing in the eggs when found on July 23, but by the 28th they had developed to the point shown in Fig. 1. Structurally these are intermediate between the very broad "stag-horn" gills of the western *Aneides* and the branched but narrower *Plethodon* gills. The eggs of *A. æneus* are enclosed by two capsules, the outer soft and thick, the inner resistant and thin.

***Desmognathus fuscus fuscus* (Rafinesque)**

I place here 104 specimens (A. M. N. H. Nos. 25193–210, 25605–611, etc.) found on Pine Mountain, July 26 through the 28th. Seven females were found guarding egg clusters and one additional cluster was secured. These clusters are formed in the usual way. The embryos are in advanced stages of development in four of the clusters, though only the eyes are pigmented. The eggs of the remaining four are in earlier stages, only the neural groove being visible in two. The eggs range in number from fourteen to thirty-three with an average of twenty-four for each cluster.

The clusters of Nos. 25606–8 were found under and in thick moss growing on a decayed log lying in a spring stream near the base of Laden Trail. These eggs were not placed directly above a flow of water. Cluster No. 25609 was found on the School grounds in Limestone

Branch under a small, flat stone embedded in a low mud-bank five feet from the main flow of water but at the edge of the rocky stream-bed. No. 25611, the cluster whose guarding adult was not secured, was also found in Limestone Branch. It was deposited some three feet above a flow of water under thick moss growing on a boulder.

The *fuscus* of this series are by no means typical but represent a gigantic local form as the following figures will show. Dunn (1926) gives measurements of a series of twenty-two males and eighteen females, all but one of which come from Virginia and Pennsylvania. For purposes of comparison I have used his measurements of the ten largest of each sex. My own measurements were made from twenty-four adults, eleven males and thirteen females, all but six of which were picked at random from ninety-seven Pine Mountain specimens. The extra six were those found guarding eggs. All measurements are in millimeters (see table on p. 12.)

In only two places do Dunn's average measurements exceed those made from the Pine Mountain *fuscus*, viz., length of tail (4.9) and total length (1.2). The figures below show the degree to which those of the Pine Mountain series exceed the typical ones.

	Length of Head	Length of Body	Length of Tail	Total Length
MALES	4	3.2
FEMALES	5.1	10.7	2.2	18.1

***Desmognathus fuscus carolinensis* (Dunn)**

While collecting Plethodons on Wayah Bald I noticed that one or two of the *carolinensis* taken had colored cheeks. Now I find in the preserved specimens that none of the seven (Nos. 25334-340) taken there has a colored cheek, but two (Nos. 25339 and 340) have light areas where the color must have been. The seven specimens were taken along the banks of the same stream.

Among nineteen specimens (Nos. 25443-454 and 25534-540) taken in one small area on Andrews Bald seven (Nos. 25443-446) still have distinct color patches on their cheeks.

Dunn has recently described a new race of *D. fuscus* from the Great Smokies. His five examples, four of which I have before me, come from Indian Gap which is very near Andrews Bald. He says that the new race, *imitator* is "very similar to *carolinensis* except for color" and gives three characters which are: colored cheeks, lead-black bellies, and lack of distinctly banded backs. Then he says that No. 72761 has an "indefinitely marked" cheek. This one then is similar to my two (Nos.

MEASUREMENTS OF COMPARATIVE SERIES OF *D. fuscus fuscus*

MALES

	Length of Head		Length of Body		Length of Tail		Total Length	
	Extremes	Average	Extremes	Average	Extremes	Average	Extremes	Average
Dunn's Series Pine Mountain Series	11.0-14.0	12.6	41-54	48.8	42-66	49.2	94 0-134	113.6
	14.5-17.5	16.6	49-56	52.0	35-53	44.3	99.5-126	112.4

FEMALES

Dunn's Series Pine Mountain Series	7.0-11.5	8.8	25.5-42	35.3	27.0-55	41.5	62-107	85.6
	13.5-14.5	13.9	41.0-50	46.0	32.5-53	43.7	86-115	103.7

25339-340) from Wayah Bald, for certainly Dunn's specimens were selected for their colored cheeks and the color in his No. 72761 has faded just as in my Nos. 25339 and 25340. In my nineteen from Andrews Bald the seven that retain the color correspond to Dunn's four remaining specimens that likewise retain definite traces of color. How many of the remaining twelve from Andrews Bald had some color in life it is impossible to say, but the cheeks of several might be styled "indefinitely marked."

The collector of the type and paratypes of *imitator* was probably unconsciously selecting his material.

As to the indistinctness of the dorsal band, I find that No. 25444, one of the seven from Andrews Bald with colored cheeks, has no dorsal stripe, while in No. 25445, also one of this seven, it is very indistinct. A third from this same lot, No. 25446, has an indistinct band, while the remaining four have normal bands.

Dunn's third character seems to be good, for the bellies of my specimens are generally lighter than those of his that I have examined. This might easily be the result of a different method of preservation.

In size there is only a slight disparity, for the two largest among my seven from Andrews Bald measure only 28 mm. body length, while Dunn's largest specimen retaining the colored cheeks has a body 32 mm. long.

Dunn's *imitator* seems to be little more than a local color variety of typical *carolinensis* and should therefore be placed in the synonymy under that form.

The American Museum of Natural History has received many large specimens of *D. fuscus carolinensis* from Gatlinburg, Sevier County, Tennessee. Andrews Bald, Indian Gap, and Gatlinburg are all in the same region. Seven among a lot of seventeen have white cheeks while the cheeks of the remaining ten are swollen and probably were colored in life. The collector, Mr. Oakley, writes of sending colored cheeked examples. All but one of this lot of seventeen have very dark bellies while the backs of some of them show traces of bands as in typical *carolinensis*. Unfortunately, this lot is in a wretched state of preservation.

From the above data we may conclude that *D. fuscus carolinensis* from the Great Smokies frequently has colored cheeks. Further field studies will show whether or not in certain regions examples without this character are lacking. Apparently here we have a species in the making and this is all the more significant in view of the fact that this same color character has been so well developed in another genus in this same region.

Dunn has called it a "clear case of mimicry." If this cheek character did not arise as a single mutation the question develops, what became of the intergrades between the coral-cheeked *P. jordani* and the species from which it sprang? Further, will the colored-cheeked *carolinensis* finally establish itself as a distinct race? The cheek color probably has little selective value and hence it seems that other changes, perhaps physiological characters which have accompanied the genesis of the cheek character, may give colored or non-colored forms the upper hand in the struggle for existence.

***Desmognathus phoca* (Matthes)**

Under *L. m. intermedia* I tell of securing 146 salamanders on Lee Mountain, the locality from which Dunn records *L. marmorata*. All but one of these I identify as *phoca*. Among them are A. M. N. H. Nos. 25342-25388 and 25390-25431.

***Desmognathus quadra-maculatus* (Holbrook)**

I found this species to be common in the streams about Highlands (A. M. N. H. No. 25254). Such localities are approximately 3800 feet above the sea. I also took it near the top of Wayah Bald (A. M. N. H. No. 25268) and high up on Andrews Bald in the Great Smokies (A. M. N. H. Nos. 25541-3). The body of No. 25541 from Andrews Bald is 70 mm. long and other large individuals were seen there. The species evidently attains a great size in this region.

One specimen taken at Highlands assumed the defensive, opening its mouth threateningly when I reached out to catch it.

***Leurognathus marmorata intermedia*, new subspecies**

TYPE.—A. M. N. H. No. 25557; ♂; Davis Gap, Waynesville, North Carolina; July 17, 1927.

DIAGNOSIS.—This new subspecies may be distinguished from *marmorata* by the presence of vomerine teeth; arched roof of mouth; smaller size; more numerous and smaller markings of the dorsum.

DESCRIPTION.—Vomerine teeth are present in the adult female and generally in the young, but they are frequently lacking in the larger males. Six out of eleven of the largest males in the series lack the vomerine teeth, while all but one of the seven largest females possess them. Even in that one a trace is present. Among seventeen immature examples the vomerine teeth are present in twelve and absent in five.

The arched, narrow roof of the mouth is in marked contrast to the comparatively flat and wide roof in *marmorata*.

The dorsum in *marmorata* is completely covered by two parallel rows of light, indefinitely outlined blotches, about six blotches in each series from the head to the base of the tail. *Intermedia* has two series of widely separated, small spots, one down either side of the back. There are about ten spots in each series to the tail.

The following table shows the relative size of the two forms. The figures represent measurements of a series of twelve adult *marmorata* and eighteen *intermedia*.

MALES							
	Longest Body	Average Length of Body	Longest Head	Average Length of Head	Widest Head	Average Width of Head	Longest Tail
<i>Marmorata</i>	60	51.7	16	14.8	12	10.8	48
<i>Intermedia</i>	52	44	15	13.8	11	10.4	40

FEMALES							
<i>Marmorata</i>	53	49	15	14.1	12.5	10.2	57
<i>Intermedia</i>	44	40.6	12	11.8	10	9.1	39

Near Waynesville on July 17 I hunted the most easterly source of Raccoon Creek, a small, clear stream that rises in the mountains forming the southern shoulder of David Gap and flows northward until it reaches the Pigeon Road where the latter passes through the bottom of the Gap. While flowing immediately beside the road for the fraction of a mile the stream turns slightly westward to make its way down the valley into Francis Cove. My work began at an altitude of about 3400 feet, just above the point where the stream first approaches the road. There the mountain side is steep and but little shaded, while the bed of the stream is a mass of loose rock and earth with almost no vegetation. Here, only *phoca* was seen, but it was present in numbers.

As one ascends, the valley narrows, becoming steeper and steeper, until it disappears entirely, forcing the water to fall over a little precipice, the top of which is about 4000 feet in altitude, or five to six hundred feet above the point where *phoca* was common. At the top of this cliff I found *phoca* scarce, while *intermedia* was abundant. In fact, they were so numerous that with my own hands I secured fifty-eight specimens (among them A. M. N. H. Nos. 25544-25580) in an hour and a half.

Moore (1899), Bishop (1924) and myself (1924) have all noted the aquatic habits of this genus and former observations are beautifully confirmed by my recent ones in this new locality. Even though living

in such a shallow, open stream the behavior of *intermedia* was in strong contrast to that of the *phoca*. When uncovered *phoca* darts or dashes wildly away over the rocks looking for a place of retreat, but *intermedia* either remains motionless on the bottom or glides gracefully to cover under water. Only when surprised out of water or teased and cornered will it behave like *phoca*.

On July 12 I visited Lee Mountain, which is very near Davis Gap, to see if it is inhabited by *marmorata* (Dunn, 1924). I found the mountain to be only 4200 feet high while the source of the highest stream is not more than 3500 feet. I hunted this stream just below its source and in four hours caught 146 salamanders, only one of which is *intermedia*. Lee Mountain does not attain the necessary altitude for *intermedia* to be abundant on it. Dunn's Lee Mountain *marmorata*, the only specimen known possessing vomerine teeth, is obviously *intermedia*.

In structure and habits this new form agrees with *marmorata*. The frequent loss of the vomerine teeth in the adult male links it up with the *fuscus* group.

SUMMARY AND DISCUSSION

EVOLUTION OF CERTAIN SPECIES OF *Plethodon*

The question of the mutual relationships of the four species of *Plethodon*, *glutinosus*, *metcalfi*, *shermani* and *jordani*, is an interesting one. When different factors are considered these four species arrange themselves in different order. For example, *glutinosus* is the largest with an average body length of 54.5 mm., while *shermani* follows, its average length being 45.3 mm.; *metcalfi* and *jordani* stand together at 40.4 and 40.3 mm., respectively. Considering the amount of difference in size between the sexes we find that *glutinosus* and *metcalfi* come together with the body length of the female exceeding that of the male 4.8 and 4.7 mm. respectively. The respective figures for *shermani* and *jordani* are .5 and 1.5 mm.

Obviously, from the foregoing accounts of habits, *shermani* and *jordani* show remarkable similarity, for both are narrowly restricted in range and live only at the highest altitudes. *Metcalfi* is here intermediate with a comparatively wider range and decided preference for considerable altitude. Quite as obviously *shermani* and *jordani* come together in regard to color, each being distinguished by a small amount of coral red on the body. However, Dunn (1925) says that the black color is deepest in *jordani* and lightest in *metcalfi*. Thus he throws *glutinosus* and *shermani* together with *jordani* and *metcalfi* at the extremes. He also puts

jordani and *shermani* at the extremes as having respectively the longest and shortest vomerine series. Again, *metcalfi* and *glutinosus* are thrown together.

Thus far, then, this discussion has lead us nowhere. The four species arrange themselves in almost as many groupings as factors considered. It would seem, however, that *shermani* and *jordani* have a certain superficial resemblance.

Disregarding the above and considering geographical distribution we find that the ranges of three, *shermani*, *jordani* and *metcalfi*, are circumscribed by that of the fourth, *glutinosus*. This would indicate that *glutinosus* is the primary ancestral stock. The question of direct ancestry remains: did *shermani* and *jordani* split directly off from *glutinosus* or are they more directly related to *metcalfi*? *Glutinosus* and *metcalfi* are intimately associated in the Southern Blue Ridge and are often found under the same log. Moreover, both Dunn (1926) and Noble (1927) record intergrades. It may reasonably be concluded that *metcalfi* has evolved directly from *glutinosus*. *Metcalfi* is not found in the Great Smokies and possibly not in the Nantahalas, but the latter range connects the Blue Ridge with the Great Smokies so it is easy to imagine that *shermani* arose directly from *metcalfi*, the two thus inhabiting adjacent ranges. The only remaining evidence of relationship is a specimen of *jordani* recorded by Dunn (1926) lacking the colored cheek, but having coral on the legs. Thus the available evidence strongly suggests that *shermani* arose from *metcalfi* and *jordani* from *shermani*. However, no good intergrades between *shermani* and *jordani* are present in either of my series. The final solution of this problem must await the discovery of further evidence.

THE STATUS OF *Desmognathus fuscus imitator* DUNN

It is interesting to find among species of two genera living in the same area a character, in the one case fixed and invariable and in the other, unfixed and quite variable. I refer to the colored cheek patch, the most conspicuous character distinguishing *jordani* from *metcalfi*. In the case of *Desmognathus fuscus carolinensis* from the Great Smokies this character frequently appears in a few individuals from any locality, but in *Plethodon jordani* it is sufficiently constant to be called a specific character. Here we see an unstable character in one species becoming fixed in another. In the genus *Plethodon* color characters such as the red legs of *shermani*, the white spots of *glutinosus*, etc., seem to have little survival value. It is hard to see how the intergrades between *jordani* and the

form from which it evolved were eliminated by natural selection. A similar process is going on at present with *carolinensis* and a study of this species might shed light on the mechanism of evolutionary changes. We cannot even conjecture as to why this color character is appearing. Dunn (1927) suggests that it is a case of mimicry but offers no evidence to support his theory.

THE ORIGIN OF THE GENUS *Leurognathus*

It has been assumed that *Leurognathus marmorata* evolved from *Desmognathus quadra-maculatus* in one step. The discovery of the new form *intermedia* shows that the change has been more gradual.

THE RELATIONSHIPS OF *Aneides xneus*

Relationship between *Aneides* and *Plethodon* is evidenced by similarity in structure as well as habits. The former genus is more specialized than the latter in both habits and structure.

All species of *Aneides*, except one, inhabit the extreme West, but this one exception is found on the Cumberland Plateau thousands of miles from its closest relatives, but closely associated with *Plethodon*. Moreover, the less modified teeth of this species indicate its close relationship to *Plethodon*. Storer (1926) maintains that the trans-continental migration of salamanders has for a large part of Tertiary time been very difficult.

In certain habits recorded above *xneus* strongly resembles *lugubris*; in certain others it resembles *Plethodon*, while in larval gill form it occupies an intermediate position.

In brief, then, *Aneides xneus* resembles *Aneides lugubris* in (a) generic characters of skeleton and (b) behavior, especially as shown by its arboreal habits. It resembles certain *Plethodons* in (a) method of egg attachment. In gill form it occupies an intermediate position.

CONCLUSIONS

1. *Plethodon shermani* and *jordani* are good species whose ranges are not intruded upon by their closest relatives, *metcalfi* and *glutinosus*.

2. *Desmognathus fuscus imitator* Dunn is nothing more than an unstable color variety of typical *D. fuscus carolinensis* and should be placed in the synonymy of that form.

3. Pine Mountain, southeastern Kentucky, is inhabited by a gigantic local form of *Desmognathus fuscus fuscus*.

4. *Leurognathus marmorata intermedia*, new subspecies, is distinguished from typical *marmorata* by its smaller size, distinctive color pattern, and possession of

vomerine teeth. It may be considered as a form intermediate between *Desmognathus quadramaculatus* and *Leurognathus marmorata*.

5. Although *Aneides æneus* is nearer to *Plethodon* than any other member of its genus, it shows still closer relationship to *A. lugubris*. Thus, its position in the genus *Aneides* is firmly established.

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AMERICAN EOCENE DIDELPHIDS

BY GEORGE GAYLORD SIMPSON

In 1884, Cope¹ described a didelphid from the Wasatch of the Big Horn Basin, Wyoming, under the name *Peratherium comstocki* (*P. comstockianum* in legend to plate). This long remained the only record of didelphids in the American Eocene. In 1909, however, Matthew² figured two specimens from the Bridger, Middle Eocene, which he considered as marsupial and probably *Peratherium* but did not name. Still more recently Troxell³ has described a Bridger specimen in the Yale Collection, under the name *Herpetotherium marsupium*. He considered this specimen as probably marsupial and suggested that one of Matthew's unnamed specimens (*loc. cit.*, Pl. XLIX, Fig. 4, Amer. Mus. No. 13046) was probably specifically identical. It is the purpose of this paper to correlate these three observations—Cope, Matthew, Troxell; to apply a name to the second specimen of Matthew, and to give some brief remarks on the evolution of the Didelphiidæ in North America.

Didelphids are abundant, indeed predominant, in our known Cretaceous mammalian faunas. In the Paleocene of this country they were supposed to be absent, but the recent work of Matthew and Granger⁴ has shown that they are present in the Puerco (*Thylacodon pusillus*) and in the Tiffany (*Peradectes elegans*). They are rare in the Eocene, about six specimens being recorded from Wasatch and Bridger, but are fairly common in the White River Oligocene. One species is also known in the John Day (*Peratherium merriami*)⁵ but no North American Miocene or Pliocene didelphids have been recorded. It has been customary to draw inferences from this negative evidence and to suppose our didelphids to have a great expansion in the Cretaceous, to be nearly or quite absent in the Paleocene and Eocene, to have another expansion in the Oligocene, and then to die out entirely and to be reintroduced from South America.

¹Cope, E. D. 1884. Vertebrata of the Tertiary Formations of the West. Rept. U. S. Geol. Surv. Ter. (Hayden). P. 269, Pl. xxva, Fig. 15.

²Matthew, W. D. 1909. The Carnivora and Insectivora of the Bridger Basin, Middle Eocene. Memoirs Amer. Mus. Nat. Hist., IX. Pp. 339, 540; Pl. XLIX, Fig. 4; Pl. L, Fig. 9.

³Troxell, E. L. 1923. A new marsupial. American Journ. Sci., V, pp. 507-510.

⁴Matthew, W. D., and Granger, W. 1921. New Genera of Paleocene Mammals. Amer. Mus. Novitates, No. 13, p. 2.

⁵Stock, C., and Furlong, E. L. 1922. A Marsupial from the John Day Oligocene, etc. Univ. Calif. Pub. Geol., XIII, pp. 311-317.

in late Pliocene or Pleistocene times. The fact that opossums are small and are largely arboreal should warn one that such conclusions are entirely unwarranted, at least as regards the number of individuals present at a given time. Thus, marsupials were supposed to be absent in the Paleocene, but in the Mason Pocket of the Tiffany beds one of the two most abundant genera is a marsupial. This happened to be a deposit of facies suitable for didelphid preservation. Most of our Tertiary deposits are not so favorable in facies, even supposing the microfauna to be adequately known, which is rarely true.

From the evidence in hand, it is clear that didelphids were present in North America from at least Belly River time until the end of the Oligocene, and that they were abundant in environmental facies suitable for them. They may then have disappeared, but their mere absence in the collections means nothing, and it is much more probable, *a priori*, that they remained in North America continuously to the present time, although unquestionably with fluctuations of northern limit as the climate varied. In the Oligocene, probably the warmest of the Tertiary epochs, they ranged well into Canada, as they had in the warm Belly River. During the glacial episodes they no doubt were forced southward with other animals not strongly resistant to cold.

In the Cretaceous the didelphids were more varied than they have ever been since. Along with some forms of more generalized type, there occurred a great variety of others with numerous differences in the development of individual cusps and clear indications of wide differences of habit. Beginning with the Eocene, however, they become almost stereotyped. After the Cretaceous, the premolars are always of simple, primitive, trenchant type; the lower molars have but one pattern, with the protoconid higher than the metaconid and the latter higher than the paraconid; the upper molars always have the normal *Didelphis*-like contour and have reduced paracones and large metacones. Despite the presence of numerous species, especially in the American and European Oligocene, the fundamental tooth-pattern is monotonously unvaried, and the only observed differences are in size and proportions. Even in the Eocene the only fairly constant known difference between the various species collectively assigned to *Peratherium* and the recent *Didelphis* lies in the proportions of the premolars, P_3 being equal to or larger than P_2 .

The known material illustrates in a rather clear way the evolution of the recent type of didelphid dentition from the more generalized of the various types seen in the Cretaceous, especially those referred to *Pedionomys* in a broad sense. In the lower molars there is little change, save that

only one of the various Cretaceous types of construction survives. The upper molars are more interesting (Fig. 1). In the Cretaceous the paracone and metacone are nearly or quite equal. In the Paleocene *Peradectes* both are well developed, but the paracone is smaller. In the species referred to *Peratherium*, the paracone varies somewhat but is always much reduced and may be quite as small, especially in the later species, as in any recent didelphid. The conules are well and equally developed in the Cretaceous, but are represented at most by vestiges in the later species of *Peratherium* and in the recent didelphids. Although always rather variable and difficult to study because of their rapid modification or effacement by wear, the styler cusps also undergo definite changes. In *Pedionomys* there are five styler cusps, of which the second (external to the paracone) is the least developed and most inconstant. As the paracone is reduced this style becomes increasingly important until in *Peratherium* and in recent didelphids it is the most constant and usually the largest. The first (most anterior) styler cusp, large and independent in the Cretaceous, becomes a mere accessory cuspule on the second. The fourth is generally reduced—it lies along the outer edge of the metastylar spur and nearly opposite the metacone, which is not reduced. This style may be lost altogether, although it is often removed by wear so that loss in some cases is apparent only. The median (third) style, almost always lower than the fourth in the Cretaceous, is retained and may become the largest of all (Fig. 1G).

In passing, it is important to note that the condition with three styler cusps, the middle one largest, which Winge and those who might be called Neo-Wingians consider as extremely primitive, is very clearly a specialized and considerably modified condition in the didelphids, a group on which they place much emphasis.

The three known Eocene species are here placed in the genus *Peratherium*, a genus ranging from upper Eocene to upper Miocene in Europe. A range for a single genus almost through the Eocene, Oligocene, and Miocene seems, at first sight, excessive, but the genus belongs to the most conservative known line of mammals. The only American Eocene species in which upper molars are known, *P. marsupium*, is clearly more advanced than the late Paleocene *Peradectes*, and it is in a *Peratherium* stage of development. None of our Eocene forms shows any definite superspecific distinction from typical *Peratherium*, although more complete material might conceivably show some such difference.

Brief specific revisions follow.

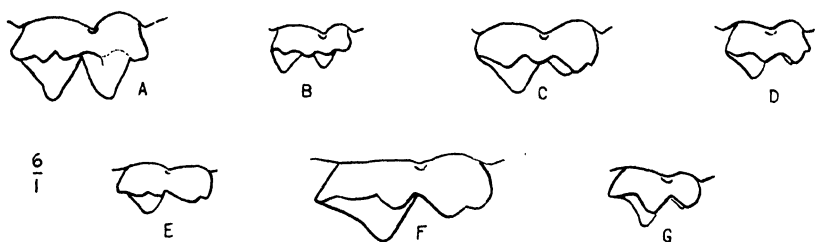


Fig. 1. External views of M^2 right, in various primitive polyprotodonts. A, *Pediomys* sp., Cretaceous. B, *Peradectes elegans*, Paleocene. C, *Peratherium marsupium*, Eocene. D, *Peratherium fugax*, Oligocene. E, *Marmosa chapmani*, Recent. F, *Didelphis* sp., Recent. G, *Phascogale macdonnellensis*, Recent. All $\times 7.5$.

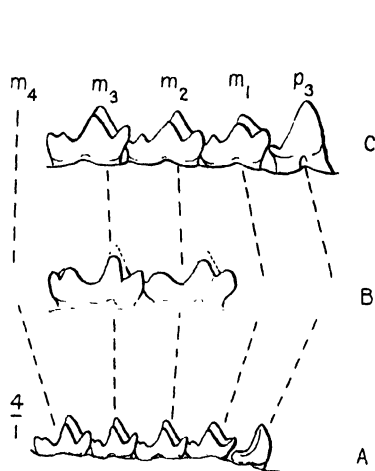


Fig. 2

Fig. 2. Internal views of left lower cheek-teeth of early didelphids. A, *Peradectes elegans*. B, *Peratherium comstocki*. C, *Peratherium marsupium*. All $\times 4$.

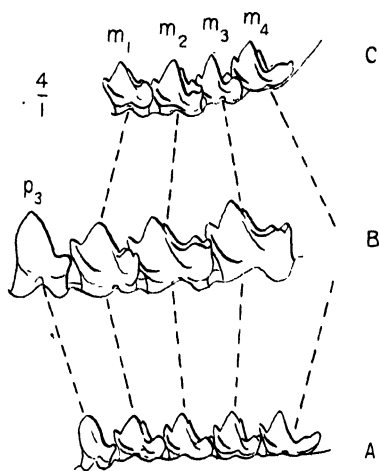


Fig. 3

Fig. 3. External views of left lower cheek-teeth of early didelphids. A, *Peradectes elegans*. B, *Peratherium marsupium*. C, *Peratherium innominatum*. All $\times 4$.

***Peratherium comstocki* Cope, 1884**

TYPE.—Amer. Mus. No. 4252. Part of left lower jaw with broken M_{2-3} . Collected by J. L. Wortman, 1881.

HORIZON AND LOCALITY.—Wasatch, Big Horn Basin, Wyoming.

DIAGNOSIS.—Trigonids low. Cusps blunt. Talonids relatively long. Length M_{2-3} , 6.3 mm.

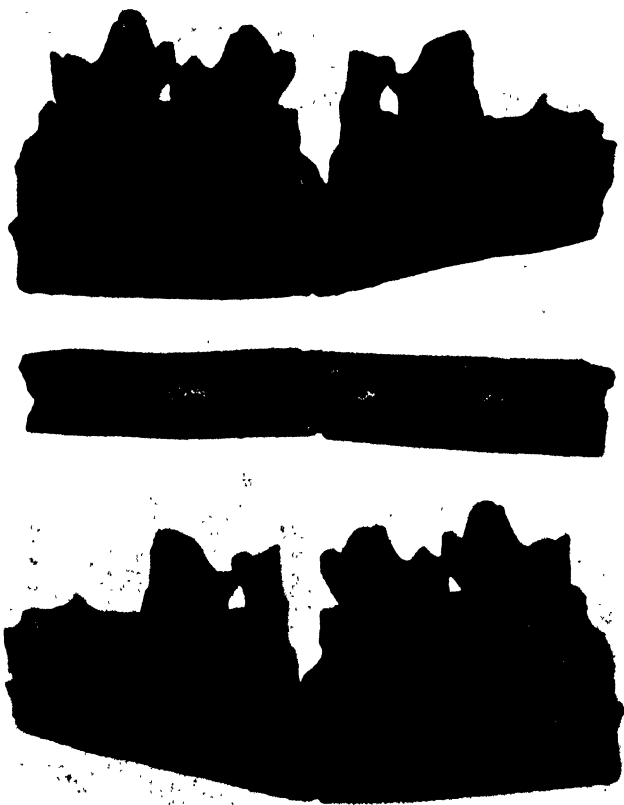
***Peratherium marsupium* (Troxell, 1923)**

Fig. 4. *Peratherium marsupium*. Amer. Mus. No. 13046. Inner, crown, and outer views of left lower jaw with P_3 , M_{1-3} . After Matthew. $\times 6$.

TYPE.—Yale Peabody Museum Cat. No. 13518. Part of right lower jaw with P_3 , M_{1-3} . Collected by J. W. Chew, 1874.

HORIZON AND LOCALITY.—Bridger, Bridger Basin, Wyoming.

DIAGNOSIS.—Low trigonids. Molars close to those of *P. comstocki*, but a little smaller, talonid relatively shorter and entoconid not so stout. Length M_{2-3} , 5.5 mm.

Amer. Mus. No. 13046 (Matthew, 1909, *loc. cit.*, Pl. XLIX, Fig. 4) belongs to this species, as Troxell considered probable. Both Matthew and Troxell considered this form as didelphid, although both with some reserve. No doubt need longer be entertained. The whole molar construction is clearly didelphid (note especially character and position of hypoconulid), and there is no question as to the presence of four molars and three premolars. The upper molars (Fig. 1C) are also obviously didelphid and agree closely with *Peratherium*, less closely with other didelphid genera. The species was referred by Troxell to *Herpetotherium* Cope, but Cope himself came to recognize that there is no valid distinction between this genus and *Peratherium*.

***Peratherium innominatum*, new species**

TYPE.—Amer. Mus. No. 11493, left lower jaw nearly complete, with M_{1-4} . Collected by A. Thomson, 1903.

HORIZON AND LOCALITY.—Lower Bridger, Millersville, Bridger Basin, Wyoming.



Fig. 5. *Peratherium innominatum*. Type. External view of left lower jaw with M_{1-4} . After Matthew. $\times 6$.

DIAGNOSIS.— $P_3 = P_2$. No diastemata. Molar trigonids high. Talonids, save that of M_3 , short. M_3 longer than preceding teeth and with elongate heel. Coronoid high and slender. Markedly smaller than other Eocene species. Length M_{2-3} about 3.0 mm.

The posterior part of the jaw is crushed, making the coronoid and articular process appear higher than they originally were and crowding the molars somewhat. As noted by Matthew, the jaw is typically didelphid, with strongly inflected angle. There is a mental foramen beneath M_1 and another between P_1 and P_2 .

59.88,1E (67.5)

A NEW SPECIES OF WAXBILL (*ESTRILDA*) FROM THE
SOUTHEASTERN CONGO

BY JAMES P. CHAPIN

During a rapid trip up the Lualaba River by steamer, from Kabalo to Bukama, in August 1927, I took advantage of every stop to collect birds on shore. At Kiabo, a post on the west bank of the river, opposite the southern end of Lake Upemba, or at 8° 46' S. latitude, I was surprised to find a flock of 20 to 30 waxbills, very similar in behavior and appearance to *Estrilda astrild*, but with no red about the eye. Instead they had a black patch in the same place, but of slightly smaller extent. They were in a level grassy plain, probably somewhat swampy when the water of the river is high during the rains, and sat amid patches of high grass and some bushes. Three specimens were secured at this locality, two adult males and a female, but none were seen elsewhere.

So far as I can discover, this species of waxbill is still undescribed, and I propose for it the name *nigriloris*.

***Estrilda nigriloris*, new species**

TYPE.—Male adult; No. 2623, Ruwenzori-Kivu Expedition of the American Museum of Natural History; Kiabo, Lualaba River, Belgian Congo; August 10, 1927.

DESCRIPTION OF ADULT MALE.—Loral region and a small space about the eye black, this color extending to a point about 4 mm. behind the eye. Along the upper loral region runs a streak of pale pinkish or whitish. Otherwise the general coloration is similar to that of *Estrilda astrild nyansæ* Neumann, except that the rosy wash of the underparts is more dilute, approaching the condition in *E. a. occidentalis* Fraser and Jardine. The throat and cheeks are more grayish white, and lightly washed with pink, while even on the back and upper tail-coverts the plumage is faintly tinged with pink. Forehead and crown only a little grayer than the ground-color of back. Hind-crown, upperparts (including wing-coverts and inner secondaries), sides of chest, and flanks barred with dark brown. Abdomen and under tail-coverts black. Rectrices largely blackish, but median ones barred with brown and black basally, and all but the outermost showing some brown with black barring on outer webs near base. Iris very dark brown, bill rather dull scarlet, feet dusky brown. Wing, 47, 48 mm.; tail, 45, 50, outermost rectrices 21–25 mm. shorter than median; exposed culmen, 7; metatarsus, 13.5, 14.

ADULT FEMALE.—Similar to the male but duller. Black of face almost entirely restricted to lores, a faint black streak behind eye. A distinct rosy wash on middle of underparts, but no pinkish tinge on upperparts. Abdomen and under tail-coverts with some brownish markings, and more brown on rectrices. Wing, 46.5 mm.; tail 43 exposed culmen, 7; metatarsus, 13.5.



Fig. 1. Adult male of *Estrilda nigriloris*.
Two-thirds natural size.

PROBABLE RANGE OF THE SPECIES.—Known only from the type locality, and not likely to be widely distributed, in view of the careful collecting by Neave in the Upper Katanga, Böhm's trip across Marungu to Lake Upemba, and Father Callewaert's extensive collections made at Luluabourg in the Kasai District. It is possible that *Estrilda nigriloris* will be found to be restricted to the swampy region about Lakes Kisale, Upemba, and the many other smaller bodies of water along this portion of the Lualaba.

It is a curious fact that *Estrilda astrild* is very rare—if not actually wanting—in a large area of savanna country which would seem well suited to its needs, south of the Congo forest in the Kasai and Lomani Districts. This area is occupied however by *Estrilda melpoda*, the common red-faced waxbill of the clearings in the Cameroon-Congo forest, the species extending southward to the upper Kwango River, Tshisika near the southern border of the Kasai District at 7° S. latitude, and Katobwe on the Lualaba, at nearly 9° S. latitude.

To the eastward, *E. melpoda* ranges as far as the northwest shore of Lake Tanganyika and the Ruzizi Valley. Nevertheless it does not reach the eastern border of the Ituri forest; and, although it ascends the Aruwimi River to a little above Panga, its place is taken at Avakubi by *Estrilda astrild occidentalis*. In general, throughout the eastern and southern Congo, the ranges of these two distinct species of waxbill are complementary and almost exclusive. In the Ruzizi Valley I noticed them together, however, and sometimes mingling in the same flock. At Boma on the lower Congo both species likewise occurred in the same marsh. Such an exact similarity in habits may play a part in deciding their geographic relationship. The type locality of *Estrilda nigriloris* lies just within the range of *E. melpoda*.

Inasmuch as the plumage of *nigriloris* bears so close a resemblance to that of *astrild* as to suggest that the black face-patch is a recent "mutation," which would not preclude intimate relationship with the latter species, it may be well to call attention to a few minor characters not found in any race of *E. astrild*.

The black face-patch is more restricted in size than the corresponding red area in *astrild*. This difference is especially marked in the female, where there is very little black behind the eye. In *astrild* a slight racial variation is noticeable, the red face-patch being unusually extensive in the richly colored *E. a. rubriventris* Vieillot of the Gaboon Coast and Lower Congo. Furthermore, the black lores of *nigriloris* are bordered above by a faint stripe of pinkish or whitish, while in no race of *astrild* is there any indication of such a marking. The red of the face impinges directly on the gray or gray-brown of the forehead.

The bill of *Estrilda nigriloris* is shorter and blunter than that of *E. astrild*, its culmen more decurved, so that the form of the bill closely resembles that seen in *E. roseicrissa*. These additional differences weigh heavily in favor of specific distinctness for my new form.

A FEW FISHES FROM THE SOUTHEAST CORNER OF THE
CONGO BASIN

BY J. T. NICHOLS

Dr. James P. Chapin has brought back a small collection of fishes, comprising only 9 species, from Ankoro, at the junction of the Lualaba and Luvua Rivers, Belgian Congo. These rivers are tributary to the Congo, but the locality lies outside the forest to the southeast, hence its faunal interest.

There are 3 catfish (*Schilbe mustus*, *Parailia longifilis*, and *Auchenoglanis occidentalis*); 2 *Barbus*; 2 cichlids; and 2 *Anabas*; one each of the last three groups here described as new.

Two specimens of *Barbus minus* Boulenger (described from British East Africa) have barbels a little shorter than described, $\frac{1}{2}$ and $\frac{2}{3}$, versus $\frac{3}{4}$ of, and a little longer than eye. *B. minus* is scarcely different from *B. neglectus* of the Nile, and probably close to *B. radiatus* of the Zambesi.

There are several small specimens of *Tilapia sparrmani* A. Smith (previously known from Angola, Lakes Mweru and Bangwelu, the Zambesi, etc.).

A single *Anabas multispinus* Peters (known from the Uelle, Zambesi Basin, etc.) has XIX versus XVII-XVIII dorsal spines.

***Barbus nigrifilis*, new species**

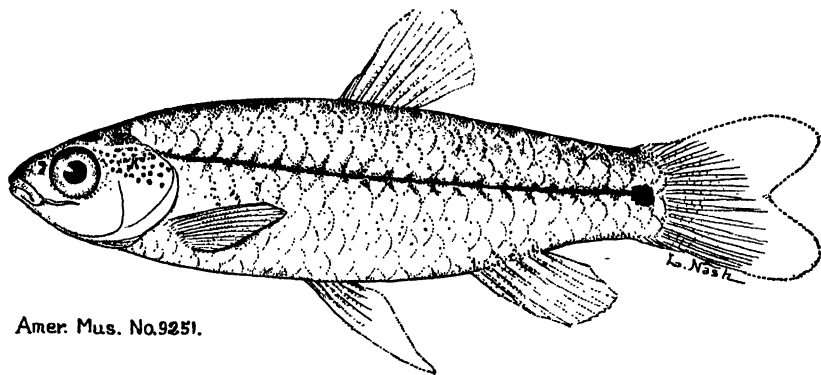
DESCRIPTION OF TYPE.—No. 9251, Amer. Mus. Nat. Hist.; from Ankoro, south-east Belgian Congo; August, 1927; collected by J. P. Chapin.

Length to base of caudal 22 mm. Depth in this length, 3.6; head, 3.6. Eye in head, 3; snout, 3.6; maxillary, 4.7; interorbital, 3; width of body, 2; depth of peduncle, 1.7; its length, 1.5; longest dorsal ray, 1.1; longest anal ray, 1.9; pectoral, 1.3; ventral, 1.4; caudal broken. Barbel 1.5 in eye.

Dorsal (broken), 8 or 9; anal, 7, 5 branched rays. Scales (many missing), about 23; 9 around peduncle.

Mouth small, sub-inferior, not reaching front of eye. A single barbel on each side. Dorsal without spinous ray; its origin over ventral base, equidistant from base of caudal and front of eye; pectoral not quite reaching to ventral, and ventral reaching to anal origin. Scales radiately striated; lateral line complete or nearly so.

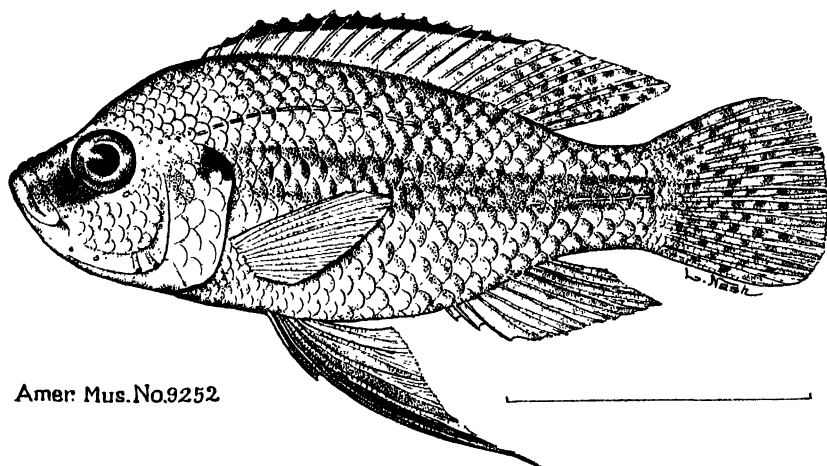
Upper part of head dark, lower part silvery; body pale, dark along the back and particularly about the bases of the vertical fins; a dark stripe along the midline from anal to caudal; a sharp black thread-like stripe on side from shoulder to base of caudal



Amer. Mus. No. 9251.

Fig. 1. *Barbus nigrifilis*, type.

where it terminates in a black spot; fins grayish. This little *Barbus* seems quite unlike anything described, but there is some uncertainty, from its being based on a single small imperfect specimen.



Amer. Mus. No. 9252

Fig. 2. *Paratilapia ventralis*, type.

***Paratilapia ventralis*, new species**

DESCRIPTION OF TYPE.—No. 9252, Amer. Mus. Nat. Hist.; from Ankoro, south-east Belgian Congo; August, 1927; collected by J. P. Chapin.

Length to base of caudal 52 mm. Depth in this length, 2.4; head, 2.7. Eye in

head, 3; snout, 3.5; maxillary, 2.8; interorbital, 3; thickness of body, 2; depth of peduncle, 2; its length, 3; longest dorsal spine, 2.9; longest dorsal ray, 1.6; third anal spine, 2.2; longest anal ray, 1.5; pectoral, 1.3; ventral, 0.7.; caudal, 1.2.

Dorsal XIV, 9; anal III, 7. Scales 26; lateral lines 16+10; $3\frac{1}{2}$ rows between lateral line and dorsal, $8\frac{1}{2}$ between same and ventral; 3 or 4 rows on cheek. An outer series of moderate, conical, slightly curved teeth, and narrow band of about 3 rows of minute teeth; 8 or 9 short gill-rakers on lower limb of first arch.

Profile slightly concave, touching upper rim of eye; nape elevated; lower jaw projecting; mouth oblique; maxillary not quite to under front margin of eye. Ventral with a stout initial spine and the first soft ray filamentous, reaching almost to anal axil; anal spines graduated; dorsal and anal lobes pointed; caudal well rounded. Scales smooth to slightly ctenoid, small on chest, forward on top of head to front of pupil. Color in spirits grayish, paler below; a dark lengthwise shade on the middle of peduncle, black blotch on corner of opercle. Pectoral pale, other fins dark grayish; spinous dorsal with a blackish margin; ventral outer margin with a pale streak, submarginally more broadly blackish.

There are 4 or 5 additional specimens of this species, which looks like *P. carlottæ* of the Zambesi form which fin and scale counts easily separate it, and is probably close to *P. dorsalis* from Brazzaville (Upper Congo) which is imperfectly known. In the genus *Haplochromis* it resembles *strigigina* and *moffati*. Boulenger's treatment of the cichlids in his 'Fresh-water Fishes of Africa' is unsatisfactory, but sometimes more easily followed than Regan's more recent papers. The former author's comprehensive use of *Paratilapia* is certainly a convenience, and the writer is not prepared to restrict that genus to a single Madagascan species as has been done.

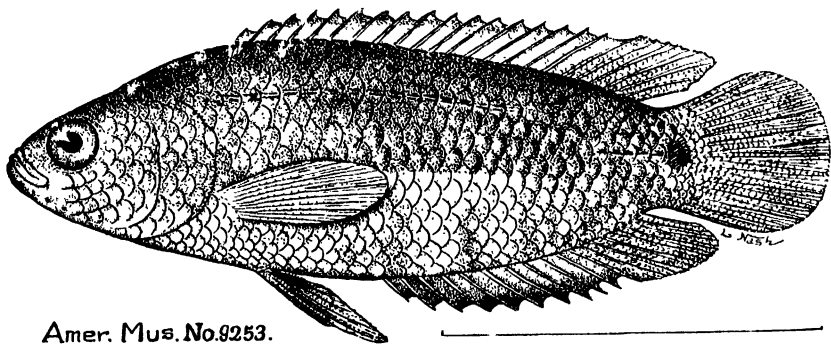


Fig. 3. *Anabas muriei ocellifer*, type.

***Anabas muriei ocellifer*, new subspecies**

DESCRIPTION OF TYPE.—No. 9253, Amer. Mus. Nat. Hist.; from Ankoro, south-east Belgian Congo; August, 1927; collected by J. P. Chapin.

Length to base of caudal 45 mm. Depth in this length, 2.6; head, 3. Eye in head, 3.6; snout, 5; maxillary, 3.5; interorbital, 4; width of body, 1.7; depth of peduncle, 2; longest dorsal spine, 2.5; longest dorsal ray, 1.7; anal spine, 2.5; anal ray, 1.7; pectoral, 1.4; ventral, 1.6; caudal, 1.3. Length of peduncle $\frac{1}{2}$ eye.

Dorsal XVII, 7; anal X, 9. Scales, 28; lateral lines 17+11; 4 rows between lateral line and dorsal, $8\frac{1}{2}$ between lateral line and ventral; 16 around peduncle.

Of normal shape for the genus, rather thick-bodied in front and strongly compressed behind; snout bluntly rounded; lower jaw slightly projecting; maxillary to under front margin of eye; a few strong serrations above and below the opercular notch, and a group of a number of smaller ones lower down. Pectoral reaching to opposite anal origin, pointed ventral reaching somewhat farther back; caudal (broken) rounded. Color dark grayish; the lower sides paler; the fins, except the pectoral, darker. Sides with faint ill-defined dark and pale cross-marks, a somewhat vertical dusky blotch at base of caudal surrounded by a conspicuous broad pale cross-shade before and behind; ventral black, margined with pale.

This form would not have been differentiated from *A. muriei* of the White Nile, but that four somewhat smaller cotypes have XVII (3) and XVIII (1) dorsal spines, confirming this slight difference, *muriei* having XIV–XVI. They have X (2) and XI (2) anal spines, a tangible difference from *Anabas intermedius* from the upper Zambesi, with VII to IX, which is also close, as is *Anabas ctenotis* Boulenger from west of Lake Tanganyika.

So far as the evidence of the present small collection is of value, it points to the locality being outside the Congo fish-faunal area, rather with East African affinities, perhaps in a transition belt where the Nile influence might be expected to be relatively strong though distant.¹ It thus affords another shred of evidence that the limits of river basins are an unsound boundary for fresh-water fauna.

¹Nichols, 1923, *Science* for Aug. 31, pp. 153–155.

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A MACKEREL (*SCOMBER SCOMBRUS*) WITH A RUBBER BAND ROVE THROUGH ITS BODY

By E. W. GUDGER

On August 1, 1927, Dr. John E. Bailey of Clinton, Conn., presented to the American Museum a specimen of the common mackerel which is the subject of this article. All that is known of the fish is that it was obtained from the market of Byron Baisden of Clinton, Conn., on July 31, 1927, and that it had been caught off Montauk or Block Island, probably on the preceding day. It came to me with the viscera in pretty bad shape, was at once put in 70 per cent alcohol, was later photographed, and has been studied in the endeavor to ascertain how this rubber band came to be rove through the body.

This fish is a specimen of the common blue-backed mackerel, *Scomber scombrus*, 13.25 inches (336 mm.) in standard length (from tip of lower jaw to the base of the caudal fin), and 15.75 inches (400 mm.) "over all" length between perpendiculars; and its girth in the region of the insertion of the rubber band is, after long immersion in alcohol, 6.25 inches (158 mm.). It came to me in fair condition so far as external parts were concerned and its torn mouth indicated that it had been caught on a hook—it was evidently feeding freely. Save for the rubber band there was nothing abnormal about it.

With regard to the band, considering the fish from the exterior, the facts are as follows. Measuring back in the mid-lateral region of the body 5.13 inches (130 mm.), we come to the hole where the rubber band was inserted about midway of the depth of the body. This hole was considerably larger than the band and allowed it to be freely drawn back and forth through the hole. The band was continuous, without knot or visible point of junction of ends—in short it was exactly as it came from the maker, a cross-section cut from a rubber tube. Being delayed in the study of the fish, and finding that the band was becoming soft from the action of the alcohol, I ran a bit of cord through the hole to mark its place.

The fish had certainly worn the band for a long time and had evidently gotten it on or in its body when the band was new and very contractile. Furthermore, it had worn this band in two positions. Study

of the figures will show that at first the band had extended squarely across the body vertically over the hole through which it ran in the body of the fish. Here it had by pressure made a distinct groove clear across the back, shallowest on the right side but much deeper (at least twice) on the left. No scales were to be found in this groove, the bottom of which was made up of the integument, here tough and (after months in alcohol) leathery. The groove was most marked in the mid-dorsal region. Here the extreme end of the first dorsal spine had been bent down but not permanently distorted. Not so, however, the second ray, which was normally the longest in the spinous dorsal. The band crossed this spine apparently about the middle. The outer half was gone and the very end was permanently bent down like a human toe that has a cramp (the "hammer toe" of orthopedic surgery). The third ray had its end bent in the same fashion. Of the fourth ray nothing was left but a rudiment of the base. Then came a space about 0.4 inches (6 mm.) long in which spines were entirely lacking. Judging by the intervals between spines one and four, there must be about two spines lacking here. All these structures point to the fact that the fish acquired the rubber band when it was new and very elastic, and that it exerted not merely a steady but a strong pressure on the fish.

Later the band (possibly losing some of its elasticity) became shifted backward 0.7 inch (17 mm.) and formed a new groove which it was occupying when it came to the Museum. Here, despite its loss of elasticity and possibly as a result of its having some "play," the band cut a wide channel across the back—4 mm. wide at the narrowest point on the dorsum, 6 mm. at the widest on the left side, and 9 on the right side. This groove is not a simple scaleless depression in the integument as is the forward groove, but is cut down through the skin and clear into the muscle segments. This cut extends downward on either side clear to the hole tunnelling the body. Marked also are the results on the spines, four of which are affected. The first one (apparently about the 6th or 7th of a normal spinous dorsal) has the extreme outer end apparently gone. Of the next spine, the point (6 mm. long) is broken off and hanging in the membrane. The third has quite half its length gone, and the fourth, like the fourth at the other groove, is reduced to a mere stump not more than 2 mm. long. This, it should be noted, lies just on the anterior edge of the groove. Caudalwards of this stump I am able to find three shorter spines (the last a mere rudiment deep in the groove). Here then can be counted 11 spines, and since the fish normally has 11 or 12 in the first dorsal, it apparently has the full number. However, in the anterior groove across

the dorsum there is lacking at least one and possibly two spines. Apparently then, if one or two spines are lacking, this fish has at least one spine too many. However, the hindmost spine of all (number 12 or 13) is a mere rudiment in this specimen, and would never have projected above the groove in which the spinous dorsal folds down. Probably it is never found and counted in any specimen.

It is plain that the anterior groove is the older, since the posterior had the band in it when the fish was brought in, and since this had the groove cut down into the very muscles. It seems probable that the band, while *in situ* in the anterior groove, cut this down also into the flesh. This has the added proof of the condition of the spines in the first groove. If this conjecture be true, then, when the band became shifted backward, regeneration of integumentary tissue across the bottom of the groove took place, but the groove was not filled in.

Close inspection of Figs. 1 and 3 will show that below the tunnel there is, on the side of the body, a distinct line from the hole to the under side of the body. This shows best on the fish's right side, but it is to be seen on the left side also, though here it is confused by a crease in the abdominal wall. This latter in its upper half is confluent with the marking referred to, but in its lower half it slants forward of the marking.



Fig. 1. The mackerel seen from the right side with the rubber band displaced toward the head. The first groove (now healed) extends across the back over the hole. When the fish was taken the rubber band, still strong and elastic, was found in the hinder and more recent groove which had been cut down into the muscles of the back. Note the mark in the skin extending ventrally from position of the band.

The marking is continued across the ventral surface of the abdominal wall. This looks as if the rubber band encircled the ventral as well as the dorsal part of the body. The data set forth in the preceding part of this paper, but especially in the last paragraph, lead to the conjecture that the band once encircled the fish, that it gradually cut through the soft tissues, that these severed tissues reunited, regenerated, and that the band thus

eventually came to rest (at least temporarily) in the position in which it extended squarely through the abdomen. For confirmation of this the fish was dissected, but a most unfortunate condition was revealed. When the fish reached me, one and possibly two days after it had been caught, the internal organs were pretty far gone, though the exterior was in fair condition. I at once made two cuts in the abdomen to admit the preservative, and immersed the fish in 70 per cent alcohol.

Months later, on opening it up, great was my disappointment to find that the greater part of the internal organs had gone to pieces and that the decomposed parts had been washed out. Furthermore, the peritoneal lining of the abdomen was gone and the body wall itself was much broken up, ribs and shreds of muscle extending out into the cavity. All that could be found was that the internal openings of the holes in the body



Fig. 2. Dorsal view of mackerel showing the band and the old and new grooves. Note the distorted spines, especially the one in the first groove. These, even better than the size and depths of the grooves, indicate the pressure exerted by the rubber band.

walls were much larger than the outer apertures, apparently indicating that that part of the band extending through the abdomen had been subject to considerable agitation and that this had caused the formation of funnel-like openings on the inner sides of the body wall. There seemed to be faint traces of vertical lines in the muscles of the inner body wall, but the muscles are in such bad condition, so frayed out, that these appearances may be and probably are entirely accidental. In any case these markings cannot be offered as evidence of the upward passage of the rubber band.

Much had been hoped for from a study of the viscera. Had the alimentary tract been held up in a loop above the rubber band, it would have been strong evidence that the band had cut through the body wall in its upward migration due to its contractility. It could not have cut through the alimentary canal without of course causing death.

For an explanation of this phenomenon, one is left largely in doubt. The band was in the position shown in the photographs, and by examination immediately after the fish was handed to me it was seen that it was absolutely continuous, without knot or any indication of point of junction of ends—it was a band made by transversely cutting a seamless rubber tube. Since this is true, it could only have gotten in place by the fish, when younger and smaller, running its head through the band and getting it round its body at the largest circumference. In proof of this, attention is called to the lines extending from the hole down one side, across the abdomen and up the other side to the other hole.

As the fish grew larger the band exerted greater pressure and presently formed a groove across the abdomen. As time went on the band cut deeper (upwardly) and regeneration took place closing up the cut



Fig. 3. View of mackerel from left side, showing conditions much as in Fig. 1. Note here the mark on the side of the fish below the hole. This is somewhat obscured by a crease in the body wall, which, however, turns forward leaving the mark fairly clear below.

below as this progressed above, until the condition came about which existed when the fish was caught. The time element here is uncertain for we do not know how large the fish was when it acquired the rubber cincture, nor do we know the life of a rubber band in salt water. But, as the facts are, there is no other explanation or even conjecture tenable. We are caught in a cul-de-sac.

But the proffered explanation is not so preposterous as it seems. Elsewhere¹ I have brought together all the available data on foreign bodies embedded in the tissues of fishes. I myself have twice found such—once a pipefish, and again the vertebral column of a fish embedded in the mesenteric folds of living and perfectly healthy fishes. I also re-

¹Gudger, E. W. 'Foreign Bodies Found Embedded in the Tissues of Fishes.' *Natural History*, 1922, XXII, pp. 452-457, 6 figs.

corded three hitherto unpublished instances from the notes of the late Vinal Edwards, of the U. S. Fisheries Laboratory, Woods Hole, Mass., and then brought forward three general statements and eight specific instances of sand-eels or similar sharp-nosed fishes found in the peritoneal cavity of other fishes. However, more remarkable still was the case of a mummified hermit-crab found in the body cavity of a cod fish.

Of metallic objects, an account was given of two cod hooks with portions of attached lines imbedded in the liver of an apparently healthy cod. Most remarkable of all was a knife with the blade closed in its brass handle ($2\frac{3}{4}$ inches long) embedded in the muscles of the back of a large cod—the flesh where the knife was found being $2\frac{1}{2}$ inches thick. Two of Vinal Edwards' specimens were of fish skeletons "in the meat near the backbone" of their fish hosts. It is hard to understand how these objects reached these positions in the muscles, but they were there.

In considering any or all of these unusual matters, the remarkable regenerative powers and relative freedom from infection of fishes among the cold-blooded vertebrates must be considered. They survive the loss of important parts and indeed often regenerate them, when such loss in the higher vertebrates would almost inevitably bring about death. I have in my possession a little fish which has lost its tail fin and yet seems hardly the worse for it. Then I have collected figures and descriptions of a large number of fishes which have suffered similar loss but in which healing has taken place, and the dorsal and anal fins, now nearly confluent, have to a certain extent taken over the function of the lost part.

These facts would seem to form the basis of the only explanation possible of the rubber band rove through the body of the mackerel under consideration.

56,81.9:14.74

THE HISTOLOGICAL NATURE OF OSSIFIED TENDONS
FOUND IN DINOSAURS

By ROY L. MOODIE

Ossified tendons, under the term "tendon bones," have been known to palæontologists for a long time, and their occurrence in the dinosaurs, especially, has been a matter of common knowledge. It would be of no especial value for me to review the literature relating to the occurrence of these objects among fossil reptiles, so I shall merely cite two papers by Barnum Brown^{1, 2}, who has written the most recent and most complete accounts of these structures.

I was attracted by the possibility of explaining the nature of some of the vertebral lesions in *Smilodon*³, on the basis of the comparative histology of the structures involved. If those curious lesions in the sabre-tooth are really myositis, then there should be some evidence of a modification in the histology of the lesions toward a ligamentous or tendinous structure. Such proved not to be the case, and I now believe those vertebral lesions of *Smilodon* to be parosteal, due to injury of the vertebræ.

Mr. Brown sent me specimens of ossified tendons from two genera of dinosaurs, *Trachodon* and *Ankylosaurus*. He also secured funds to pay for making the photomicrographs, shown on the accompanying figures. The tendons sent for study were of the size of lead-pencils, and where weathered showed the osseous appearance so well known to experienced fossil-hunters. Their fibers run longitudinally without interruption.

Although there have been a number of studies on the histological nature of fossil bone, no attempt has been made previously to describe the histology of petrified tendons, so the results given herewith are all

¹Brown, Barnum. 1916. *Corythosaurus casuarius*. Skeleton, Musculature and Epidermis. Second Paper.

Bull. Amer. Mus. Nat. Hist., XXXV, Art. XXXVIII, pp. 709-716, Pls. XIII-XXII. On page 711, under the caption "Tendons and musculature," is given the pertinent discussion.

²———. 1917. A complete Skeleton of the Horned Dinosaur *Monoclonius*, and Description of a second Skeleton showing Skin Impressions.

Ibid., XXXVII, Art. X, pp. 281-306, Pls. XI-XIX. "Ossified tendons," page 290. Plates XII and XVI show the arrangement of the tendons especially well.

³Moodie, Roy L. 1927. Studies in Paleopathology, XIX. Vertebral Lesions in the Sabre-tooth, Pleistocene of California, resembling the so-called *Myositis ossificans progressiva*, compared with certain Ossifications in the Dinosaurs. Annals of Medical History. IX, No. 1, pp. 91-102, Figs. 1-11.

new. I have reviewed elsewhere¹ the literature of fossil histology, and further reference to that subject need not be made here.

Cross and longitudinal sections of the ossified tendons of *Trachodon* and *Ankylosaurus* reveal the histological characters. One who is accustomed to examining the microscopical structures of ancient fossil bone is at once impressed with the absence of vascular spaces, which are extremely abundant in skeletal bone. The arrangement of Haversian systems is strikingly regular, and there is no evidence of stellate cells, or bundles of tissue, so characteristic of recent tendons. Osteoid tissue, so abundant in the skeletal parts of fossil reptiles, is strikingly absent from the fossil tendons. There is an interesting similarity in the histology of the ossified tendons and pathological fossil bone in the tendency in both to the production of fairly perfect Haversian systems. The systems seen in the tendons are quite perfectly formed and include all the principal elements, i. e., lacunæ, lamellæ, canals, fibrillar ground substance, and absorption areas. I cannot be sure of an intercommunication between the canaliculi of adjoining lacunæ. The lacunæ, in fact, on closer examination (Fig. 2, B), are not definitely arranged in concentric layers, between the quite apparent lamellæ. The lacunæ show a number of definite canaliculi, springing both from the two poles and from the sides of the spindles. However, they agree in general with the structure, form, and size of other dinosaurian lacunæ.

Bacterial invasion, through vascular channels, of the lacunæ and canaliculi is known to have taken place with similar results from the Devonian ostracoderms down to the Pleistocene mammals and to this common occurrence the ossified tendons of the two Cretaceous dinosaurs offer no exception. Fig. 6, A, shows several lacunæ invaded and enlarged by the bacteria of decay, whose activities were stopped and their effects preserved by fossilization.

SUMMARY

The histology of the ossified tendons of two genera of dinosaurs is structurally unlike that of the skeletal bone of fossil reptiles, in the presence of fairly well-developed Haversian systems. In this respect the tendons approach the structure of mammalian long bones. There is an absence of osteoid tissue in the tendons. The concentric lamellæ are few, rarely more than six. The lacunæ are shaped like those seen in skeletal bones of dinosaurs, and the canaliculi are few, short, and unbranched.

¹Moodie, Roy L. 1926. Studies in Paleopathology, XIII. The Elements of the Haversian System in normal and Pathological Structures among fossil Vertebrates. *Biologia Generalis*, II, pp. 63-95, 12 Plates, 10 figs.

Figures 1 to 6

Fig. 1

A. Cross section of an area in an ossified tendon, from near the sacrum, of a dinosaur, *Trachodon annectens*. Lance Formation, near Hell Creek, Montana. $\times 50$.

The sharp, dark lines are cracks filled with calcite. There is considerable interstitial material between the Haversian systems, and absorption areas are evident.

B. High-power photomicrograph of same area, $\times 100$. It will be noted from the varying sizes of the Haversian canals that the Haversian systems are not continuous for any great distance, but tend to pinch out. There are only a few systems which are oblique, the majority running in the direction of the length of the tendon. Vascular spaces, so abundant in the skeletal bone of ancient reptiles, are wanting here.

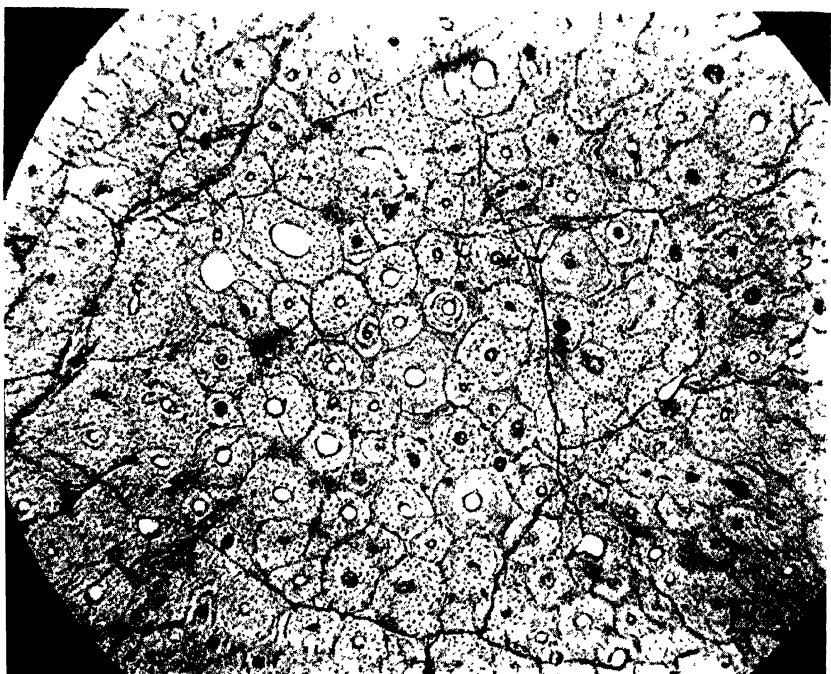
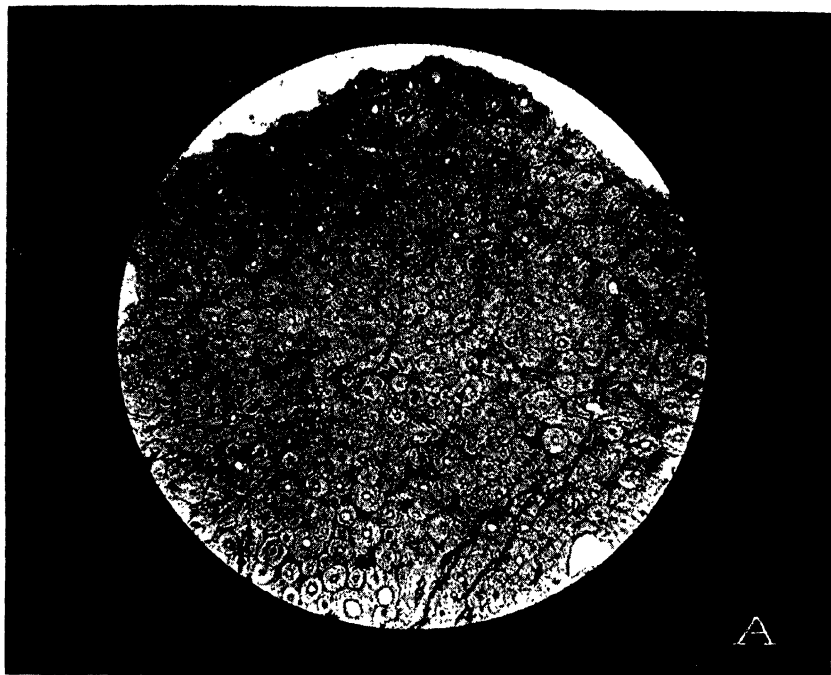


Fig. 2

A. Another area of the same slide, $\times 100$, showing less distinct boundaries to the small Haversian systems.

B. Same section, $\times 300$. Enlarged view of some of the Haversian systems, showing varying sizes. The concentric lamellæ are evident in the upper right-hand corner of the figure, and adjoining this system is an absorption area which does not differ essentially from an area in modern human bone. The interstitial ground substance has lacunæ of unmodified type. The dark line running obliquely across the bottom of the figure is a post-fossilization crack.

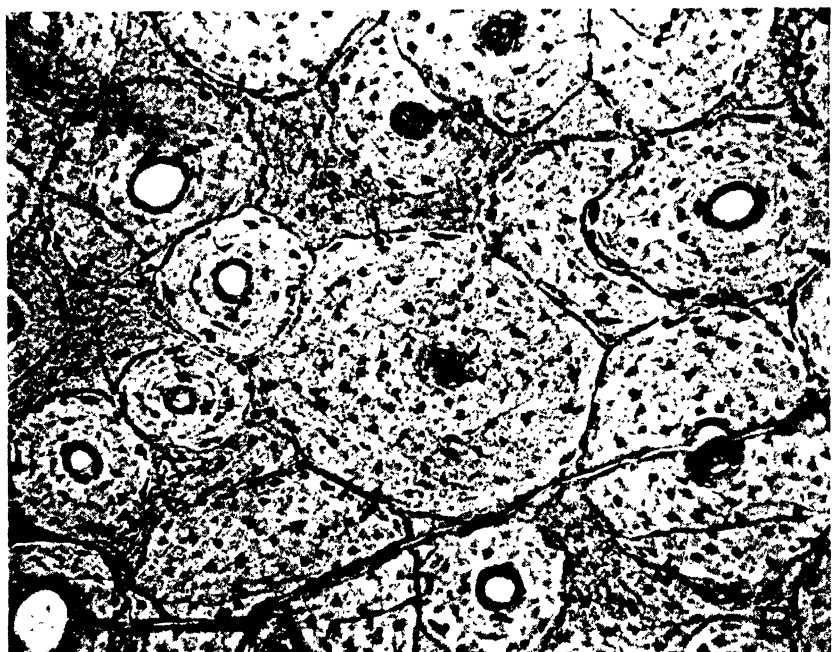
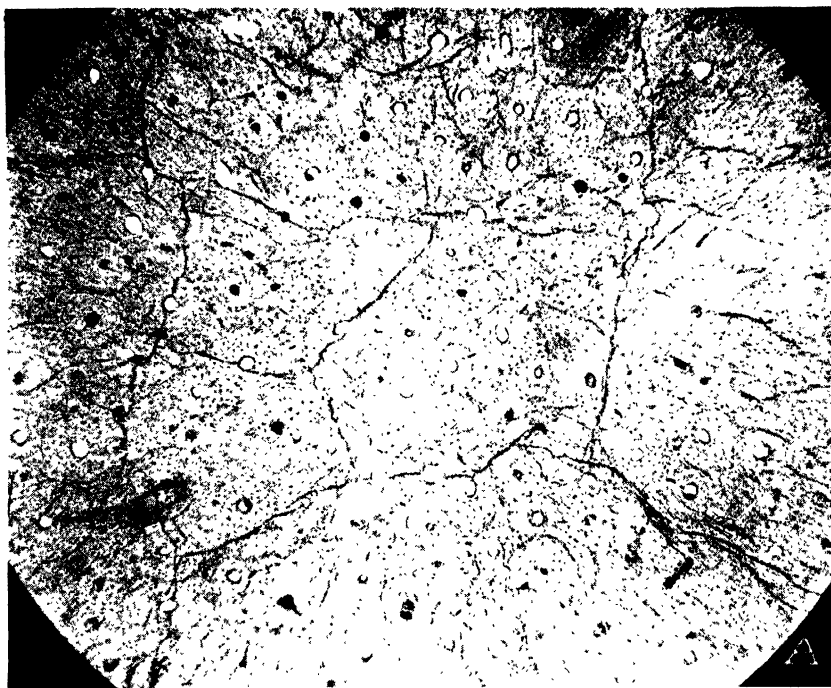


Fig. 3

A. Cross section of ossified tendon from the tail of *Ankylosaurus*, Lower Edmonton Beds, Red Deer River, Canada. $\times 50$. This is quite different in appearance from the similar section in *Trachodon* (Fig. 1, A). The concentric lamellar are distinct. The Haversian canals are quite large, some of them oblique. The ground substance is almost homogeneous.

B. Same area, enlarged $\times 150$. When compared with Fig. 2, A - this tendon in *Ankylosaurus* is seen to be widely different. The lacunae are indistinct and indifferently arranged. The opacity of the field indicates a different chemical composition from that found in *Trachodon*, due doubtless to a different matrix.

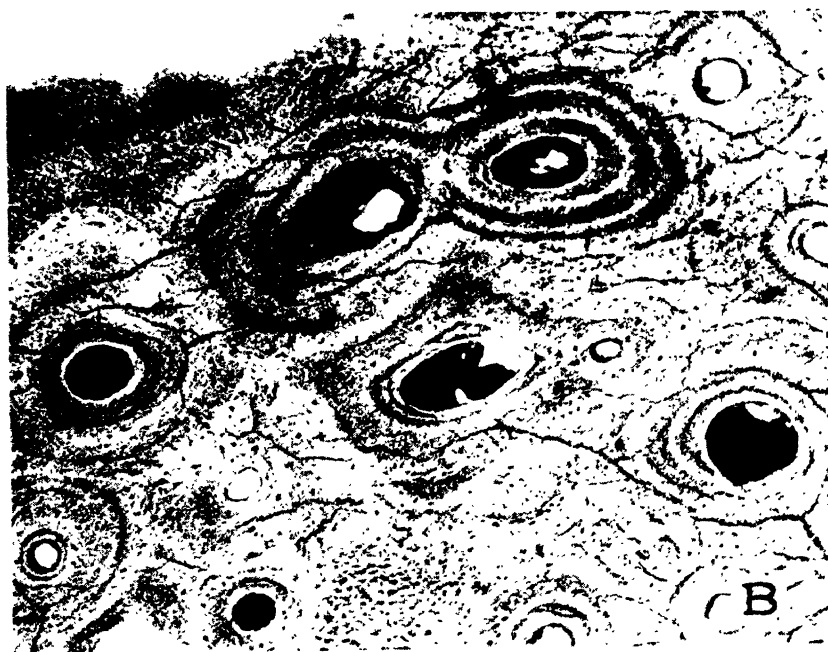
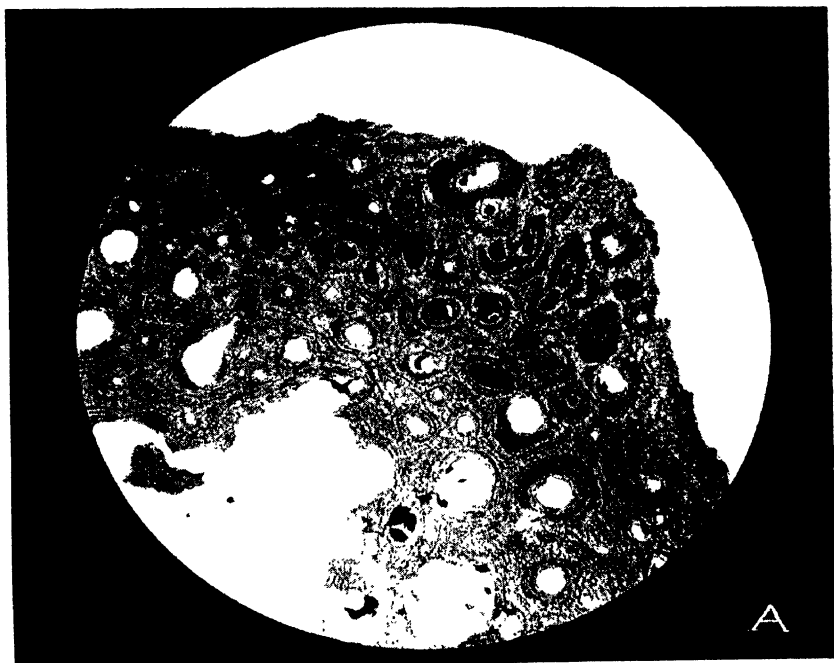


Fig 3

Fig. 4.

A. Longitudinal section of an ossified dinosaur tendon, from near the sacrum of *Trachodon annectens*, from the Lance Formation, near Hell Creek, Montana. $\times 70$.

Two Haversian canals are shown, one extending across the field. Others are cut obliquely. The orderly arrangement of the lacunæ is attractive. The lacunæ are small and numerous.

B. Same section, enlarged $\times 150$. Upper part of field has numerous cracks. Some of the lacunæ in the lower part of the field are quite large, as if invaded by bacteria.

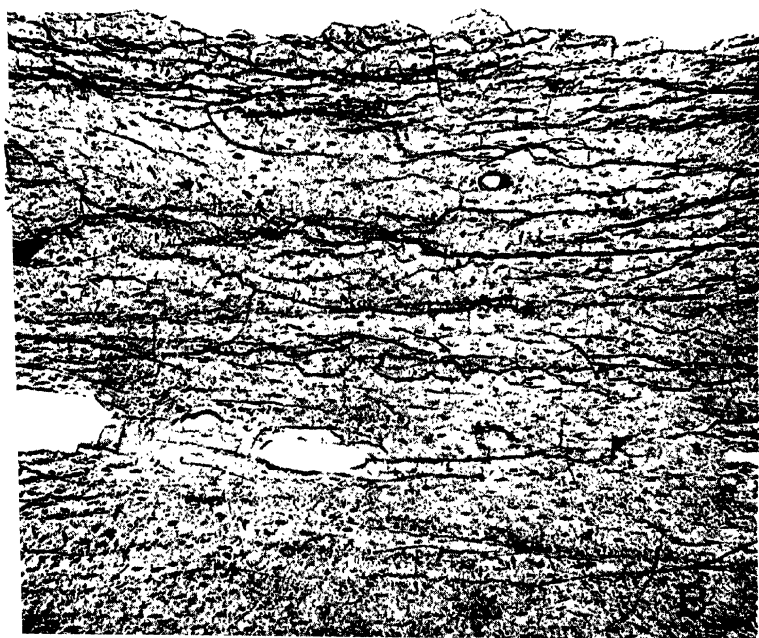


Fig. 5

A. Longitudinal section of an ossified tendon from near the sacrum of *Trachodon annectens*. Lance Formation, near Hell Creek, Montana. $\times 300$.

This shows the early effect of the invasion of lacunæ by bacteria of decay, before fossilization. The canaliculi are hypertrophied. Normal lacunæ in dinosaur bone possess only brief canaliculi. The three lacunæ shown in the middle above are figured enlarged to 600 diameters in Fig. 6, A.

B. Longitudinal section of an ossified tendon from the tail of *Ankylosaurus*. Lower Edmonton Beds, Red Deer River, Canada. $\times 50$.

The Haversian canals have the appearance of vascular spaces. The lamellæ and lacunæ are indistinct. The entire area presents a dull opacity wanting in the sections of *Trachodon*.

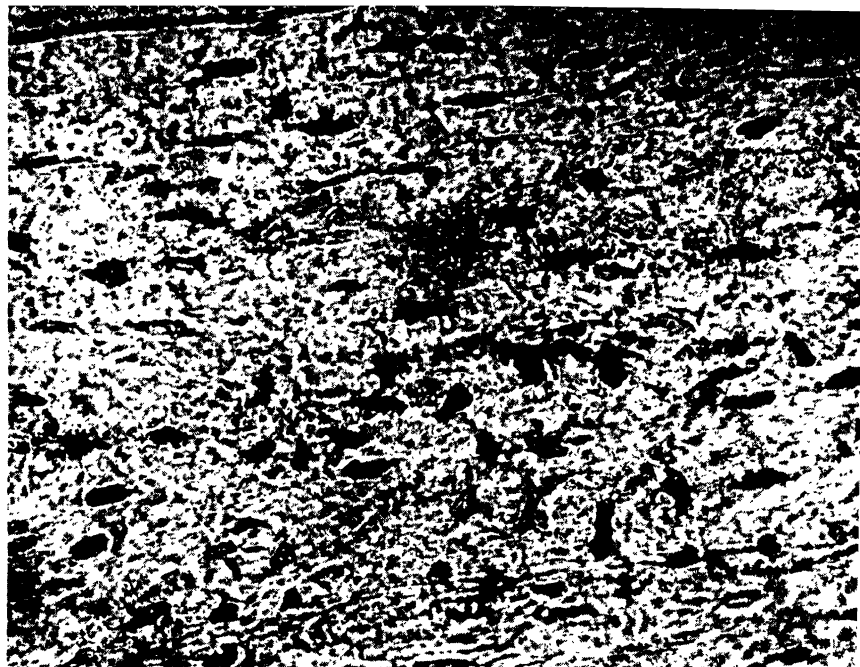


Fig. 6

A. Lacunæ, some of them invaded by bacteria, seen in longitudinal section of ossified tendon of dinosaur, *Trachodon annectens*. Lance Formation, near Hell Creek, Montana. $\times 600$.

In the lower part of the field is a structure, running obliquely from right to left, which has the appearance of a perforating fiber of Sharpey. The fibrillæ are distinct. A similar structure is seen in the upper part of the field shown in B. Another is shown cutting the upper left corner of A.

B. Another area of same section. $\times 600$. Numerous lacunæ are shown cut at different angles. The normal, uninvaded, lacunæ present short canaliculi. The ground substance has a fibrillar structure.



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MULTITUBERCULATES IN THE WASATCH FORMATION

BY WALTER GRANGER AND GEORGE GAYLORD SIMPSON

Multituberculates had long been known from the Triassic and Jurassic when Lemoine (in 1880) made the sensational discovery that they occur in the Thanetian Paleocene fauna of Cernay-les-Reims in France. Cope soon found them also in the American Paleocene, and it has since been established that they are as characteristic of the Paleocene as of the Mesozoic. Their presence along with varied archaic placentals came to be considered as diagnostic of the Paleocene, and their final extinction was supposed to coincide with the close of this epoch and immediately to precede the incursion into North America and Europe of true Eocene mammalian faunas. It was, then, surprising and important to find that multituberculates occur also in Eocene beds in Wyoming, as first briefly announced in 1914¹. The present paper is devoted to the description of these last stragglers of the oldest order of mammals.

The first specimen was found by Granger in 1912, three miles southeast of the mouth of Pat O'Hara Creek in the Clark Fork Basin. It is stated in field notes to have been in definite association with *Eohippus* and *Pelycodus*, and there is no doubt that it is from the horizon later named Sand Coulee. The Sand Coulee beds overlie the Clark Fork beds and are marked by the first appearance of true Eocene mammals, including for the first time perissodactyls, artiodactyls, rodents, and adapids. The Clark Fork horizon, following Matthew, is generally considered as representing the close of the Paleocene, and in any event the Sand Coulee is certainly post-Paleocene and represents the lowest levels of the classical Wasatch Formation, as refined by recent faunal studies.

In the following year, 1913, three additional specimens were found by William Stein at the head of Big Sand Coulee in the same region. These are associated under field numbers with typical Wasatch mammals, including *Eohippus*, *Diacodex*, and *Pelycodus*. This fact and the other field data indicate that these also are from the Sand Coulee beds. This series of four finds, made at different localities in different years and by different collectors, in each case with similar, surely Eocene, associated mammals, seems to remove all possibility of error or accident and to make

¹Granger, W. 1914. On the names of lower Eocene faunal horizons of Wyoming and New Mexico. Bull. Amer. Mus. Nat. Hist., XXXIII, p. 205.

it certain that multituberculates do occur here in post-Paleocene strata.

The remains all belong to the specialized ptilodontid *Eucosmodon*. This genus appears to range from the Puerco into the Sand Coulee—a span including four very distinct successive mammalian faunas through which no other genus is known to range. It may, therefore eventually be found that two or more related genera are included, but the present specimens, while obviously belonging to new species, afford no clear generic distinctions from the Puerco *Eucosmodon americanus*. Two species appear to be present, but only one is now definable.

***Eucosmodon ultimus*, new species**

TYPE. —Amer. Mus. No. 16103, part of left ramus with P_4 and M_1 and associated right P_4 . Collected by W. Granger, 1912.

HORIZON AND LOCALITY. —Sand Coulee Beds, Wasatch Formation, Clark Fork Basin, Wyoming.

DIAGNOSIS. —Length P_4 , 11.4 mm.; fourteen serrations on margin; relatively long and low. Length M_1 , 7.3 mm.; maximum width, 3.7 mm.; six external and four internal cusps.

Eucosmodon, as defined by Matthew and Granger, is a ptilodontid genus characterized by the absence of P_3 and by the large, compressed, sculpiform lower incisors. The present type does not include any part of the incisor, and its alveolus, while present in large part, is too badly crushed for accurate measurement. Two multituberculate incisors from the Sand Coulee beds are included in the collection, however, and both are of the sort characteristic of *Eucosmodon*. One, A. M. No. 16782, has a maximum height (*i.e.*, maximum diameter of transverse section) of 6.1 mm. and maximum width of 2.6 mm. This incisor has nearly the same dimensions as that of *E. americanus* but the enamel band is markedly wider, especially on the median surface.

The other incisor, A. M. No. 16783, probably belonged to a different species from the first, although we prefer not to attempt its definition on this material, especially as it is not quite certain which kind of incisor belonged with the cheek teeth named *E. ultimus*. This second incisor has a maximum transverse diameter of 7.3 mm., and a maximum width of 2.6 mm., being larger but more compressed than No. 16782. It is the largest *Eucosmodon* incisor known.

P_4 has a contour long and low relative to that of P_4 in *Ptilodus*, a character shared by all but one of the several known species of *Eucosmodon*, described and undescribed. It is slightly larger than the homologous tooth of *E. americanus*, and much smaller than that of *E. molestus*,

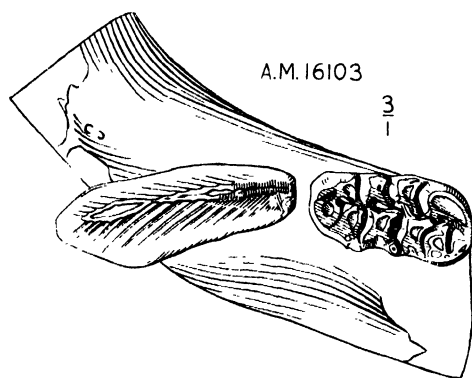


Fig. 1. *Eucosmodon ultimus* Granger and Simpson. Crown and external views of type specimen. Three times natural size.

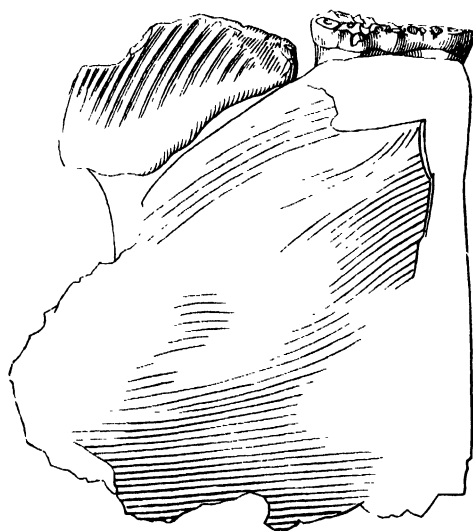


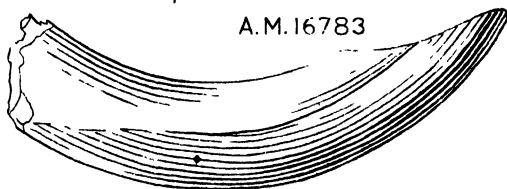
Fig. 2. *Eucosmodon*. External views and transverse sections of two incisors from the Sand Coulee beds. Twice natural size.



A.M. 16782

2
1

A.M. 16783



although the incisor of the latter is slightly smaller than the smaller of the two from the Sand Coulee.

M₁ is larger and has more cusps than in *E. americanus*, distinguishing the two species even more sharply than does the premolar. The most posterior of the six external cusps is the smallest on the tooth, while the first and last of the four internal cusps are elongate and enlarged. All of the cusps have the rather complex, plicated pattern characteristic of ptilodontids generally. There is a small conical accessory cupule externally, between the third and fourth main outer cusps, and there are indications of other still smaller tubercles on this side of the tooth.

The jaw is deeper and more robust than that of *E. americanus*.

The fourth specimen, A. M. No. 16098, includes only the posterior part of a right M₁, which agrees closely with that of the type.

The drawings in this paper are by John Germann.

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THE AFRICAN CUCKOOS OF THE GENUS *CERCOCOCCYX*

BY JAMES P. CHAPIN

Restricted in range to tropical Africa, the genus *Cercococcyx* Cabanis¹ is allied to *Cacomantis* and *Cuculus*; but the cuckoos composing it are birds with relatively small bodies, large wings, and especially long rectrices. Their colors are dull dark gray or olive-brown above, often with slight green or bronze luster, and sometimes barred with light rufous brown. The underparts are buffy white to light buff, barred on throat and breast at least with blackish.

Some species of *Cuculus* dwell in forests, others are found usually in savannas with trees or bushes; but *Cercococcyx* is always confined to woodlands, and as a rule to heavy forest. Its representatives are of so wary a nature as to be difficult to collect. Fortunately for the ornithologist they have loud voices.

The first species to be discovered was *Cercococcyx mechowii*,² secured by Major von Mechow in northern Angola. The type is preserved in the Berlin Museum, where in 1921 I compared it with a male specimen procured by the American Museum Congo Expedition at Avakubi in the Ituri Forest. The outstanding characters of the species are the grayish cast of the crown, upper back, and rump, the back without barring in the adult, the upper tail-coverts with marginal spots or broken bars of whitish or light brown; and the relatively rich buff coloration of the tibial feathering and under tail-coverts, which are generally without dark markings in the adult. The outer webs of the remiges are conspicuously barred with light rufous brown, this barring usually extending to the larger secondary coverts.

In several museums of Europe and the United States I have examined twenty-four skins of *mechowii* from the following localities. Gold Coast: Commendah; Cameroon: Bitye, River Ja, Assobam; Belgian Congo: Avakubi, Medje, Nala, Poko, Semliki Valley; Angola, presumably the northern part; Uganda: Mpanga Forest, Sezibwa River, Mabira Forest, Mpumu, Kyetuma.

¹1882, Journ. f. Orn., p. 230 (type: *C. mechowii* Cabanis).

²Cabanis, 1882, Journ. f. Orn., p. 230 (type locality: Angola).

There is little or no sexual difference in size. The specimen from the Gold Coast has the wing 130 mm., tail 170. Adults from Lower Guinea to Uganda are larger, with wing 132–146 mm., tail 179–206 mm. Additional specimens from Upper Guinea alone will show whether it is occupied by a smaller race of the species, but thus far I have found no color difference upon which to base subspecies.

After prolonged acquaintance with *Cercococcyx mechowii* in the Upper Congo, I can vouch for its strictly sylvan habits. It does not show itself even in clearings in the forest, and is only occasionally heard in second-growth woods. Typically a bird of untouched lowland forest, it may ascend to at least 5200 feet, as in the forest east of the Rutshuru Valley. Two very different kinds of notes are heard from this cuckoo. One is a triple high-pitched whistle, keeping in the same key, which I recall by the words "feet-feet-feet" or "wheet-wheet-wheet," and often reiterated during many minutes. The other is a descending series of many "silvery" notes, lasting perhaps three seconds, and not likely to be repeated soon. The same bird will often give both calls; but I think they are uttered only by males, which by careful stalking can be found perching amid leafy boughs, usually 15 to 40 feet above the ground.

For many years the genus *Cercococcyx* was believed to be monotypic, although as a matter of fact skins of another species lay unrecognized in the British Museum. This second species occurs almost throughout the range of *mechowii*, save in Uganda; and by virtue of its similarity it escaped detection until 1912, when the Vienna Museum received two examples from the forested mountains along the eastern edge of the Rutshuru Valley (Congo-Uganda border), where Rudolf Grauer had collected them at an altitude of 1600 meters. Dr. Sassi noticed the differences in coloration, and named the new form *Cercococcyx olivinus*;¹ pointing out at the same time that this species ranged westward to Cameroon and Togo, as evidenced by skins in the Berlin Museum.

The color-characters described by Sassi hold good. The back and rump of *olivinus* are of a dusky olive-brown, and the crown but little grayer. The barring on the outer webs of the remiges has all but disappeared, only faint marginal spots of rufous brown remaining. The ground-color of the breast is buffy white, much the same as in *mechowii*, but the blackish bars are often fewer or narrower, with a tendency to a point near the shaft of each feather. Still more diagnostic is the very

¹Sassi, 1912, *Annalen Naturhist. Hofmus. Wien*, XXVI, pp. 341, 378 (type locality: Forest of eastern Border Mountains of Rutshuru Plain, 1600 m.). During a visit to this forest in May 1927, I heard both *mechowii* (up to 5200 ft.) and *olivinus* (up to 4400 ft.).

pale buff of tibiae and under tail-coverts. The under tail-coverts are unmarked in the adult, but the tibiae may have dark barring.

In various museums of Europe I have examined twenty-two skins of *Cercococcyx olivinus*, in addition to one in the Field Museum, one in the Museum of Comparative Zoölogy, and five collected by the American Museum Congo Expedition. One of the latter was compared with the type in Vienna. The list of localities whence the specimens came follows. Gold Coast: Fantee; Cameroon: River Ja, Bitye, Esamesa, Bipindi, Metet; Belgian Congo: Avakubi, Babonde, vicinity of Kilo, Bolovet (in Semliki Valley), Forest E. of Rutshuru Valley, Katapena (Lower Katanga); Angola: Ndala Tando.

My measurements show no sexual difference. Three birds from the Gold Coast and one from Fantee have wings 139–144 mm., tail 163–175. Twenty-four from Lower Guinea to the eastern Congo border: wing, 136–156 mm.; tail, 160–195.

The wing of *olivinus* averages some 8 mm. longer than that of *mechowi*, yet its tail averages 11 mm. shorter than that of *mechowi*, although in both measurements there is considerable overlapping. Comparison of wing and tail-length in the same adult individuals has shown that in *olivinus* the length of wing is from 76 to 88 per cent of that of the tail,¹ whereas in *mechowi* it is from 66 to 76 per cent. These proportions seem not to hold good for young birds.

The fact that these two lowland species of *Cercococcyx* have so nearly the same distribution might lead to the conclusion that they were simply based on differences due to sex or age, or represented color-phases of the same bird. I have collected adults of both sexes of both species. From a few measurements taken in the flesh it would seem that *olivinus* has a distinctly larger body than *mechowi*. Moreover, the voices of these cuckoos are so different that my "bird-boy" Nekuma told me they had distinct names in the Mangbetu tongue: "Makwakwa" for *mechowi*, and "Nekongoli" for *olivinus*.²

Males of *olivinus* give two distinct calls, and are heard at night more often than *mechowi*. The shorter one might be compared with the descending three-syllabled call of *Cuculus solitarius*, but the first syllable is weak, and from a distance only the two following may be audible: "(whi), whow, whow." These notes are frequently reiterated. The other kind of call is a protracted series of whistles, low in tone, which might be

¹The tail must be measured with care from the base of the median rectrices, and the wing flattened along the rule.

²Chief Kongoli, who lived one day's march north of Rungu (Uelle District), was said to have been named after the bird.

written "whow," changing little in pitch, but increasing in vigor and volume, each note occupying about $\frac{3}{4}$ of a second, and the whole often lasting 10 or even 15 seconds. This second type of call is not often repeated.

Following up the notes of *olivinus* does not often lead to success. The male birds call as they perch in heavy forest, usually 30 to 60 feet above the ground; but they are even shyer than examples of *mechowi*, become silent when approached, and are all but impossible to find.

So far as I can determine, *Cercococcyx olivinus* does not vary geographically. A word of explanation may here be inserted as to *C. mechowi wellsi*.¹ At Ndala Tando, northern Angola, Dr. Ansorge collected six specimens of *olivinus*; but as Angola was known to be the type locality of *mechowi*, Ansorge's series was not unnaturally regarded as typical material of the latter species. The Cameroon-Uganda series of *Cercococcyx* in the British Museum, including as it did a large proportion of *mechowi*, averaged much darker in color than the half-dozen *olivinus* from Angola. Bannerman's type of *wellsi* is a dark-colored specimen of *mechowi*; but on the whole I cannot separate Cameroon specimens of this species from those of the Congo, Uganda, or northern Angola.

Our knowledge of the breeding habits of these cuckoos is still fragmentary, but it would be surprising if they were other than parasitic. At Avakubi in the Ituri district of the Congo, on September 27, I found a pure white egg in the oviduct of a female *olivinus*. At the same locality; on July 10, my helper Nekuma shot a young *Cercococcyx* in first plumage, the feathers of its head and back, and those of its throat to a less degree, being margined with rufous. He reported that it was being fed by a small brown babbler, *Illadopsis fulvescens ugandæ*. It has not been possible to identify this young *Cercococcyx* with certainty, but I believe it to be *mechowi*, if only because of the conspicuous barring of the remiges and greater wing-coverts. The underparts are thickly barred, and show none of the streaked pattern of which traces are retained by a young bird—presumably *olivinus*—collected by G. L. Bates at Bitye, Cameroon, February 15, 1913, now in the British Museum. Bates' young *olivinus* still shows some feathers on the middle of the throat and the lower breast, remnants of the juvenal plumage, with blackish shaft-streaks 1.5 to 2.5 mm. wide. It has rufous margins on the feathers of crown, back, and upper wing-coverts; but no barring on the greater wing-coverts, although the outer webs of remiges are somewhat barred. The under tail-coverts are light buff with dark chevron-marks.

¹Bannerman, 1919, Bull. Brit. Orn. Club, XL, p. 7 (type locality: River Ja, Cameroon).

Young birds of *C. mehowi* may show signs of barring on the scapulars, but the banded appearance of the upperparts in the young of both the foregoing species is mainly due to the rufous margins of the feathers. For some years past, however, the museums at South Kensington, Tring, and Vienna have contained ten or more skins of *Cercococcyx* which showed rather distinct rufous-brown barring on the back. These were always regarded as young individuals of *mehowi*,¹ and undoubtedly some of them are immature, with rufous feather-margins on the head and back. Where the juvenal plumage persists, some of the feathers of throat and lower breast show a streaky pattern, due to elongate lunulate marks on the middle of the feathers. All the specimens of which I now speak were secured on the mountains along the eastern border of the Belgian Congo, save one from South Angoniland, southwest of Lake Nyasa. In 1921 these birds puzzled me greatly, for I could not distinguish them from *mehowi*. It now appears that we were all mistaken, that some of the specimens are adults, and that they represent a distinct mountain-dwelling species, heretofore unrecognized.

Late in 1926 I reached the western slopes of the Ruwenzori Range. In the lowland forest between Irumu and Beni (eastern Congo) I had heard the call of *Cercococcyx mehowi* on two or three occasions, but during our stay in the mountain forest of Ruwenzori neither *mehowi* nor *olivinus* was heard. On the other hand, we listened many times to notes which might well be attributed to a *Cercococcyx*. One recalled the triple whistle of *mehowi*, but usually was of four syllables, and could be represented by the words "see-which-fits-best." This phrase, shrill rather than musical, would be repeated again and again, without pause. Occasionally it was lengthened to five syllables, or very rarely shortened to three. At other times, from the same places, came more leisurely notes which had a certain resemblance to the "whow, whow, whow. . . ." of *olivinus*. But the maker was plainly different, for the syllables were soon doubled to "three-cow, three-cow, three-cow . . .," the whole performance lasting for ten or fifteen seconds, and stopping abruptly. Then the "see-which-fits-best" might start up from the same spot. On other occasions a leisurely "you-too, you-too, you-too . . .," not unlike the "three-cow" note, would be repeated an indefinite number of times.

The thick, tangled vegetation and the steepness of the slopes rendered all efforts to see the bird futile, and beyond a doubt the maker of the notes was exceedingly shy. Finally, on December 21, my gun-

¹Ogilvie-Grant, 1910, Trans. Zool. Soc. London, XIX, p. 423; Sassi, 1912, Annalen Naturhist. Hofmus. Wien, XXVI, p. 377.

bearer Njombo brought me a *Cercococcyx* which he had shot without hearing it call. It was an adult male, with slight enlargement of the testes, but differed from both the lowland species in having faint rufous-brown bars on the back, while the outer webs of the remiges were even more broadly barred with rufous-brown than in *mechowi*. On January 3 the same black hunter again secured a similar bird; but as neither was heard to call, my assumption that the notes we heard so frequently were those of a *Cercococcyx* still lacks verification.

No doubt remains, however, as to the specific distinctness of this cuckoo of Ruwenzori, for which I propose the name *montanus*.

***Cercococcyx montanus*, new species**

SPECIFIC CHARACTERS.—Allied to *C. mechowi*, Cabanis, but lacking the grayish tinge on crown, back, and rump, where the ground-color is of a dark olive-brown, and there is a faint greenish gloss. Back lightly barred with rufous brown in the adult, crown sometimes showing narrow buffy shaft-streaks, upper tail-coverts with bars of rufous brown, often interrupted in the middle. Rufous barring of the upper surface of rectrices more extensive or more nearly complete; and rufous bars on the outer webs of remiges broader and more conspicuous. Throat and breast barred with blackish, much as in *mechowi*, ground-color of upper chest pale buffy, that of remainder of breast more whitish. Tibial feathering and under tail-coverts buff; tibiae often barred with blackish, and under tail-coverts sometimes unmarked, but often spotted or barred with black.

DIMENSIONS.—Wing, 134–149 mm.; tail, 182–201 mm.; exposed culmen, 17–20 mm.

TYPE.—Male; No. 1699, Ruwenzori-Kivu Expedition of The American Museum of Natural History; Kalongi, 6900 ft., Butahu Valley, Ruwenzori Range. Its measurements are: wing, 139 mm.; tail, 201; exposed culmen, 18. In this specimen the middle of the crown is without light markings, the under tail-coverts are uniform buff. Colors of naked parts were noted as follows: iris dark brown, rim of eyelids lemon-yellow; gape yellowish green, maxilla blackish, mandible olive-green with blackish tip; feet chrome-yellow with a tinge of ochre, claws dark gray.

JUVENAL PLUMAGE.—Among the specimens collected by Grauer, there is one, in the museum at Tring, so young that the wings and tail have not attained their full length, and measure respectively 106 and 68 mm. It was taken in the mountain forest northwest of Lake Tanganyika on July 1, 1908. The feathers of the back are not definitely barred, but the whole upperparts appear to be barred, because each feather has a rufous margin all around, from the forehead to wing-coverts and upper tail-coverts. Likewise on the underparts the juvenal plumage is entirely retained. The pattern here, while it cannot strictly be described as streaked, is very different from the dark barring of adults, or of young which have molted their first (= juvenal) plumage. The throat is dusky, streaked with white, and all its feathers loosely margined with cinnamon-buff or light rufous. The upper breast is still more blackish, the white of the feathers being restricted to an irregular bar, separated from the buff-edged tip by a broad blackish space. On the middle of the lower breast the pattern

again becomes streak-like, though the elongated dark mark on each feather is in reality lunulate. Behind this region all the feathers are generously edged with white, and on the blanks and tibiae the feathers are barred, dusky and white. The under tail-coverts are very pale buff, with a blackish chevron-bar near the tip, and with more directly transverse bars basally.

MATERIAL EXAMINED.—Fourteen skins of *Cercococcyx montanus* have been examined, distributed among five museums. British Museum (Nat. Hist.): one ♀ from South Angoniland, Nyasaland, Oct., 1900, collected by T. I. Binnie; one ♂ adult from Mubuku Valley, 7000 ft., E. Ruwenzori, Jan. 11, 1906, R. B. Woosnam. Zoölogical Museum, Tring: an adult ♂, Mountain forest N. W. of L. Tanganyika, June 27, 1908; a young ♂ from preceding locality, July 1, 1908; an adult ♀, Wau Island, Lake Kivu, Nov. 14, 1907; an immature ♂ from West of Ruzizi, E. Congo, Nov., 1908—all four collected by R. Grauer. Vienna Museum: three ♂ and two ♀, all from mountain forest N. W. of L. Tanganyika, 2000 m., Feb.-March, 1910, R. Grauer. American Museum of Natural History: adult ♂ and ♀ from Kalongi, 6900 ft., W. Ruwenzori, Dec. 21, 1926 and Jan. 3, 1927, respectively. Museum of Comparative Zoölogy: one ♂ adult, Bagilo, 5000 ft., Uluguru Mts., Tanganyika Terr., Sept. 28, 1926, A. Loveridge.¹

RANGE OF THE SPECIES.—Mountain forests above 5000 feet, from Ruwenzori south to Lake Tanganyika and the highlands southwest of Lake Nyasa, also the Uluguru Mountains in eastern Tanganyika Territory. On the western slopes of Ruwenzori we heard the notes which I attribute tentatively to this cuckoo as high as the upper margin of the bamboo zone, close to 9000 feet. On the northwestern slopes of Ruwenzori, near the Luami River, I again heard them as low as 5300 feet. Within 24 hours, descending into the adjacent lowland forest of the Semliki Valley, I listened to the calls of *C. mechowii* and *olivinus* as well.

In early March near a place called Mulu, some twelve miles northwest of Lake Edward, I again heard several birds giving the above-mentioned calls in mountain forest at 8100 to 8300 feet; but as usual they eluded me. Farther south, in the mountains west of Lake Edward, on the Kivu volcanoes, and on the mountains west of the Ruzizi Valley, I failed to hear them; but it is likely that there are certain seasons when the birds seldom call.

The distribution of *Cercococcyx montanus* is certainly discontinuous, because of its habitat requirements; yet it is likely to be discovered in many places within the limits outlined above. Possibly the species may be found divisible into races. For example, the light brownish markings on the upperparts, including wings and tail, of Loveridge's specimen from the Uluguru Mountains are more extensive and conspicuous than in the three known from Ruwenzori, and the dark bars on the breast may be

¹Reported as *C. olivinus* by Friedmann, 1928, Ibis, p. 78.

While the wing apparently increases in length toward the east and south, the tail does not vary correspondingly. The longest tail (201 mm.) is that of the type specimen from Ruwenzori, the skin from Angoniland has a tail of 189 mm., that of the Uluguru Mountains 182 mm. So in this species the proportion of wing to tail-length is less diagnostic than in the lowland members of the genus. Specimens of *C. montanus* from the eastern Congo and Ruwenzori have wings 69 to 76 per cent as long as the tail, and the two from Angoniland and the Uluguru Mts., 79 and 81 per cent, respectively.

In these days of Formenkreis study, it may be wondered whether *Cercococcyx montanus* is not simply a mountain race of one of the older-known species. In the barring of the wings and the relatively long tail of many specimens it resembles *mechowi*, but there is no approach to the grayish coloration of back and rump of that species. If my supposition as to its voice proves correct, it will be clear that in this respect the mountain form differs from both of those in the lowlands. Consequently I prefer to regard the genus as composed of three species.

In conclusion, we may be permitted to indulge in a little speculation as to the possible origin and evolution of the group. Faunal studies in the tropics have demonstrated that mountain forms are not usually to be regarded as ancestral to lowland relatives, and that the reverse is more probable. The way in which some of the color-characters of *mechowi* and *olivinus* are combined in *montanus* may be an argument in favor of the antiquity of the mountain form, which would then have arisen from some primitive lowland-dwelling *Cercococcyx*, and after becoming adapted to life in the cooler mountain forests, would have spread to suitable localities in eastern tropical Africa.

The origin or differentiation of the two lowland forms, which now live side by side in the same forests, is more problematic. Parallel cases are not wanting in Africa; and as such we may cite: *Apaloderma narina* and *æquatoriale*, in the Cameroon-Congo forest; *Scotornis climacurus* and *Caprimulgus fossii*, which are really not generically distinct, and occur together in parts of the Kasai district; *Bæopogon indicator* and *clamans*, in the Cameroon-Congo forest; and *Estrilda nonnula* and *atricapilla*, which occur together in parts of the Cameroon and Upper Congo.

Whether or not such forms arose by mutation is not the main point. Geneticists regard virtually all hereditary characters, whether strongly or slightly marked, as mutational in origin. But how have the mutational characters escaped "swamping" in the mass of population? Some, to be

sure, are of such a kind that they do become established as color-phases, individuals of the different colors interbreeding, while the nature of the "genes" insures the perpetuation of the color-phases. But in the cases cited above, the color differences are relatively slight; the two forms do not interbreed, so far as we know: and their voices are often radically unlike. There is what we may call a sexual indifference or aversion, and this must be the most important factor bearing on the evolutionary development of the forms in question. It is my belief that the sexual indifference arises only through isolation of some sort, and among birds this is usually geographic segregation.

It may of course be argued that sexual indifference results from changes in the voice or in courtship which arise concurrently with the external characters distinguishing two divergent forms. But I cannot recall any observation of such a coincidence within the same area. In the case of a number of birds exhibiting distinct color-phases, we know the reverse to be true.

The ranges of *Scotornis climacurus* and *Caprimulgus fossii*, for the most part, are kept separate by the equatorial forest belt, where neither species of goatsucker is truly at home. But in relatively recent times the long-tailed northern *Scotornis* has found its way across the narrowest part of the forest belt, in the neighborhood of the Sanga River, and has become thoroughly established in the northern Kasai drainage. During the earlier period of isolation, a sexual aversion had been developed, and this now insures the distinctness of the two species.

In the case of the forest-loving trogons of the genus *Apaloderma*, it seems possible that originally only *A. æquatoriale* dwelt in the Congo-Cameroon forest. Meanwhile *A. narina* may have occupied some separate wooded area in eastern or southeastern Africa, where even now it is found alone. Later it spread into the forests that sheltered *A. æquatoriale*. In the present connection it is of interest that we have in Africa another trogon, *Heterotrogon vittatus*, living in mountain forests, and very nearly congeneric with *Apaloderma*.

The comparison between these trogons and the cuckoos of the genus *Cercococcyx* is particularly apt. But where the two distinct forest areas were, in which *mechowi* and *olivinus* might have developed specific distinctness, remains dubious. To-day we have the forests of Upper Guinea and Lower Guinea, each with a number of mutually representative species. Supposing that *C. olivinus* was once restricted to Upper Guinea, and *C. mechowi* to Lower Guinea, we have perhaps an explanation of the apparent absence now of *C. olivinus* from the forests of Uganda,

though *C. mehowi* is found there. That the spread of *mehowi* to Upper Guinea and the invasion by *olivinus* of Lower Guinea were relatively recent might then be inferred from our failure to discover any subspecific differences.

KEY TO THE SPECIES OF *Cercocoryx* (ADULTS)

- 1.—Back more or less distinctly barred with rufous brown on a dark olive-brown ground-color, upperparts with a faint greenish gloss; outer webs of remiges and greater wing-coverts always broadly barred with rufous brown; tail always exceeding 180 mm. in length, wing varying in length from 69 to 81 per cent of tail. *C. montanus*.
 Back not barred, but plain dark gray or olive-brown, often with a faint gloss; outer webs of remiges may be barred or spotted with rufous brown, or uniformly dusky brown; tail, 160 to 206 mm. long. 2.
- 2.—Outer webs of primaries, secondaries, and greater wing-coverts conspicuously spotted or barred with rufous brown; crown, back, and rump distinctly dark gray in color; wing usually less than 75 per cent as long as tail.
C. mehowi.
 Outer webs of remiges faintly spotted, if at all, with rufous brown, the greater wing-coverts scarcely so marked; back and rump distinctly dark olive-brown in color, crown little if at all grayer; wing always more than 75 per cent as long as tail. *C. olivinus*.

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NEW CENTRAL AMERICAN SNAKES IN THE AMERICAN MUSEUM OF NATURAL HISTORY¹

By E. R. DUNN

Thanks to the kindness of Dr. G. K. Noble, I have recently been able to examine the collections of Central American snakes in the American Museum. I refer particularly to the old Cope collection from Costa Rica, the Mannhardt-Halter collection from Nicaragua, and the R  thling collection from Mexico. These collections contain a good many interesting and a few new forms.

GEOPHIS

The small Central American ground snakes allied to *Geophis* are in a rather mixed condition. *Geophis sall  i* has the hemipenis single, the sulcus forked, and the distal half of the organ covered with fringed calyces. The proximal edge of the calyculate region is free and hence the organ is "capitate," the proximal one-fourth is smooth, and the remaining one-fourth has a few hooks. This type of hemipenis is practically that of *Carphophis*, which differs from *Geophis* and the related genera as follows:

	ANT. TEMP.	NASAL	ANAL
<i>Carphophis</i>	Present	1	2
<i>Geophis</i>	Absent	2	1
<i>Atractus</i>	Present	2	1
<i>Adelphicos</i>	Present	2	2

Atractus has a very different hemipenis from that of *Geophis*, as it is deeply furcate, and spinous, and noncalyculate, throughout.

Adelphicos has enormous geneials, a completely spinous hemipenis, and the sulcus is not forked as it is in the other three, which, if correct, means that it is not at all related.

The Central American forms which Boulenger places in *Atractus* seem much more closely allied to *Geophis*. They differ from it by having an anterior temporal. The hemipenis is practically that of *Geophis*. These are three Mexican species: *latifrontalis*, *longiceps*, and *isthmicus*. None of them were seen by Boulenger. A specimen of *longiceps*, collected

¹Contribution from the Department of Zo  logy, Smith College, No. 123.

by R  thling, Amer. Mus. No. 19733, no locality, has the hemipenis single, the sulcus forked, the distal third calyculate, the proximal one-sixth smooth and the remaining one-sixth with hooks. Its position is evidently much closer to *Geophis* than to *Atractus*, but I am loath to propose a new genus based solely on peneial characters, and the only other distinction between the two is the presence or absence of the anterior temporal.

The snakes referred by Boulenger to *Dirosema* (1894, Cat. Snakes Brit. Mus., (2) II, p. 294, type *Geophis bicolor* G  nther) belong, with one exception, to *Geophis*. The type differs only in the slightly greater distinctness of the head. These are:

1. *Geophis bicolor* G  nther, Mexico (= *Rhabdosoma guttulatum* Cope).
2. *Geophis omiltemanum* G  nther, Mexico (*omiltemanum* may belong with *longiceps* as the first temporal is present, the other two lack it).
3. *Colobognathus brachycephalum* Cope, Costa Rica (this specimen was not seen by Boulenger).
4. *Calostoma psephotum* Cope, Costa Rica. This snake was not seen by Boulenger, but the type, and three specimens from Navarro, Costa Rica, collected by me and now in the Museum of Comparative Zo  logy, demonstrate clearly that this snake is a *Ninia*, with the hypapophyses and hemipenis of that genus.

Dirosema collare Werner (1923, Zool. Anz., XXIII, p. 197, Mexico) is probably a *Chersodromus* as it has a single prefrontal.

Sonora michoacensis (Cope)

A. M. N. H. Nos. 19714-6; Distrito Federal, Mexico; collected by P. D. R. R  thling.

Sonora seems to be the proper generic term for the back-fanged snakes allied to *Tantilla* but possessing a loreal. The synonymy of the genus is as follows:

Sonora BAIRD AND GIRARD, 1853, Cat. N. Amer. Rept., pt. 1, p. 117 (type, *S. semiannulata* Baird and Girard).

Chionactis COPE, 1860, Proc. Acad. Nat. Sci. Philadelphia, p. 241 (type, *Lamprosoma occipitale* Hallowell).

Scolecophis COPE, 1860, *op. cit.*, p. 259 (type, *Calamaria atrocincta* Schlegel).

Tantilla bocourti (G  nther)

A. M. N. H. No. 19735; Distrito Federal, Mexico; collected by P. D. R. R  thling.

I assign this specimen to *bocourti* rather than to the allied *Tantilla deviatrix* Barbour. *Bocourti* was based on two examples from Guanajuato, with ventrals 172-176, and caudals 55; this specimen from the

Federal District has 195 ventrals and 57 caudals; *deviatrix* from San Luis Potosi has 154 ventrals and 63 caudals. The coloration of all is alike. *Bocourti*, however, has the eye half as long as the snout (one-third in *deviatrix*); internasals more than half as long as prefrontals (less than half in *deviatrix*). These four specimens perhaps represent one species, yet as three of them agree in the head characters, and as the fourth differs in head characters, it is more conservative to let both species stand.

***Tantilla striata*, new species**

TYPE.—A. M. N. H. No. 19745; male; Mixtequillo, Oaxaca, Mexico; collected by P. D. R. Rütthling.

Scales 15; ventrals 165; anal divided; caudals 42; rostral as deep as broad, visible from above; internasals broader than long, half as long as prefrontals which are also broader than long; frontal hexagonal, very obtuse-angled in front and acutely angled behind; shorter than parietals, about twice as wide as supraocular; longer than its distance from tip of snout; parietals longer than their distance from tip of snout; eye more than half as long as its distance from tip of snout; nostril nearer internasal than to first labial; postnasal in contact with preocular; oculars 1-2; temporals 1-1; labials $\frac{7}{6}$, third and fourth entering eye, four lower labials in contact with the anterior chin shields which are longer than the posterior; anterior chin shields in contact with symphysial; brown; adjacent halves of rows 3 and 4 white; row 8 and adjacent halves of row 7 white; belly white, with brown spots anteriorly; head brown, two white flecks at tips of parietals; point of meeting of rostral, internasals, and prefrontals white; juncture of upper labials 1 and 2 white; upper labial 5 white; lower labials brown.

This snake is apparently distinct from its allies *reticulata* (*virgata*) and *miniata*. The first, from Panama, Costa Rica, and Nicaragua, has about the same coloration of three light stripes, but a much higher caudal count (57-67), and the head markings do not agree with the present specimen. The second, from Mexico, is nearer in scale count (V. 147-152, C. 55), but the coloration is quite different, there being five dark stripes.

The hemipenis of this snake is not forked nor is the sulcus divided; the distal third is occupied by calyces, the median third by many small hooks, and the proximal third is smooth with a large basal hook and one smaller one.

***Tantilla calamarina* Cope**

A. M. N. H. Nos. 19750, south of Santa Fe, Distrito Federal; 19743, near El Ocotillo, Nayarit; 12775, four miles north of Colima, Colima; 12776, Tecoman, Colima; 19746, five miles east of Tecoman, Colima; 19744, no locality.

This snake has a somewhat different hemipenis from that of *Tantilla striata*. Calyces occupy the distal two-fifths, the proximal fifth is smooth, and the two-fifths in between is occupied by a few large hooks of varying size, numbering about eight.

***Tantilla depressa*, new species**

A. M. N. H. No. 19747; female; Mixtequillo, Oaxaca, Mexico; collected by P. D. R. Ruthling.

Scales 15; ventrals 113; anal divided; caudals 14 plus. Rostral much flattened, portion visible from above equals its distance from frontal; internasals and prefrontals wider than long; frontal hexagonal, obtuse-angled in front, right-angled behind, more than twice as wide as supraocular, longer than its distance from tip of snout, shorter than parietals, which are shorter than their distance from tip of snout and longer than their distance from the rostral; postnasal touching preocular on right, not touching it on left; eye one-fourth its distance from tip of snout; oculars 1-1 temporals one on each side; labials $\frac{5}{6}$, the third entering the eye, the fourth in contact with the parietal; three lower labials in contact with the single pair of chin shields which are in contact with the symphysial. Yellow, a dark line on every scale row, except the second, which is marked by a dot on each scale, and the first, which is unmarked; the three middle and the three outer of these eleven lines fuse and form a dorsal and two lateral head stripes.

This very distinct form is allied only to *calamarina*. The extremely flattened head is unique in the genus, and is an example of the tendency seen in the larger *Ogmius* and *Stenorhina*.

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RESULTS OF THE DOUGLAS BURDEN EXPEDITION TO THE ISLAND OF KOMODO

IV.—FROGS FROM THE EAST INDIES¹

BY EMMETT REID DUNN

The frogs which form the subject of the following notes were taken by the Douglas Burden Expedition to the Island of Komodo in the summer of 1926 and are from the islands of Pulo Weh (north of Sumatra), Java, Bali, Lombok, Sumbawa, Komodo, and Wetar. There are 26 species and 2 subspecies in the collection, which consists of 611 specimens of frogs and 690 tadpoles. There is one new species, and the tadpoles of two forms are herein described for what seems to be the first time. The two frogs from Komodo are new to the island.

Megophrys monticola Kuhl and v. Hasselt

The name as here used is that of both genus and species, as chosen from two forms of each in the original description by the authors, acting as their own first revisers. Ten adults and twenty tadpoles were taken at Tjibodas, Java, alt. 4700 feet. The tadpoles were found in both still pools and swift brooks. One of these was taken in the same pool as a tadpole of *M. hasselti*. Therefore there is not complete ecological segregation of the two, although they seem generally in two different places. Smith (1917, Journ. Nat. Hist. Soc. Siam, II, p. 271 and 1926, Proc. Zool. Soc. London, p. 983) has recorded careful observations of these peculiar tadpoles and has found that their strange mouthparts are definitely correlated with their equally strange feeding habits. The same was shown by him to be true of the tadpole of *Microhyla achatina*. Similar mouthparts are to be found in certain species of the American genera *Phyllobates* and *Phyllomedusa* (Dunn, 1924, Occ. Pap. Mus. Zool. U. of Michigan, CLI; Lutz, 1924, C. R. Soc. Biol., XV, p. 241). In the American cases no ecological segregation was observed, nor were the feeding habits of the *Phyllobates* seen. The two sorts of *Phyllobates* tadpoles, however, behaved very differently in the same pool, and the modified tadpole of *Phyllomedusa* fed at the surface, as do *M. monticola* and *M.*

¹Contributions from the Department of Zoology, Smith College, No. 146.

achatina. The two *Phyllobates* with modified tadpoles, although closely related to other species with normal tadpoles, nevertheless, form a natural group of two species, distinguished not only by a peculiar tadpole type, but also by a unique sexual dimorphism.

It is therefore somewhat strange to find Dr. G. K. Noble remarking (1925, Amer. Mus. Novitates, No. 165, p. 6, and 1927, Ann. New York Acad. Sci., XXX, p. 77): "They ('unusually produced lips') do not seem to have any phylogenetic or adaptational significance," and, "this sudden appearance of an expanded mouth seems the least adaptive of all . . . larval features."

His denial of adaptational value to the produced, funnel lips of these forms is somewhat qualified by his remark (1927, p. 102) that one species of *Phyllomedusa* "has its mouth produced into a funnel to assist it in surface feeding."

***Megophrys hasseltii* (Tschudi)**

Thirty tadpoles from Tjibodas.

***Bufo cruentatus* Tschudi**

Two specimens from Tjibodas.

***Bufo melanostictus* Schneider**

Two from Pulo Weh and four from Buitenzorg. The note was heard in the latter place. It was a trill very like that of *B. americanus*. They were breeding on the nights of May 7 and May 24. On the latter day a male was taken in amplexus with a female of *Bufo asper*.

***Bufo asper* Gravenhorst**

These toads were out and calling their loud explosive hoot on the night of May 24 in the nearly dry bed of the river through the gardens at Buitenzorg. Six were taken and many more could have been. The male has a horny callosity on the upper side of the thumb.

***Bufo biporcatus biporcatus* (Gravenhorst)**

Eleven specimens of this toad were taken: two from Buitenzorg, where the soft trill was heard on the night of May 7; three from Tjibodas; and six from Bali.

***Bufo biporcatus cavator* (Barbour)**

Eighteen specimens from Suela, near the east coast of Lombok, at about 1300 feet elevation. The note is the same as that of the Javanese

form and was heard on the night of July 26. This toad was described from near Ampenam on the west coast as a full species, on the basis of a single specimen. This series shows that many of the characters, "smaller tympanum . . . circular . . . upper boundary . . . not . . . formed by the orbito-tympanic ridge," are subject to variation. Some specimens are exactly like *biporcatus* from Java and Bali in these respects; others differ and are like the description of *cavator*; still others are intermediate. The whole series is much lighter in color than western specimens. Under these circumstances I deem it proper to regard the Lombok toad as a subspecies.

***Oreophryne monticola* (Boulenger)**

Nine specimens, taken at altitudes of from 6000 to 9000 feet on Rinjani, Island of Lombok. Since it was the dry season (July 23-26) the specimens seemed to be aestivating. Nevertheless, at Tangaña (9000 feet) I heard a faint "ticky ticky ticky" the night of July 23, which may have been the note. A female 30 mm. long had ovarian eggs 3 mm. in diameter, which perhaps indicates a direct development. The smallest specimen was 14 mm. in length and the digital disks were rather undeveloped. A male has a dark throat. This is a true *Oreophryne*, as a specimen kindly cleared for me by Dr. G. K. Noble shows, and the girdle does not differ from that of *O. celebensis*, as figured by Mehely (1901, Termész. Füzetek, Pl. x, fig. 1). The procoracoid reaches the scapula.

***Oreophryne jeffersoniana*, new species**

TYPE.—A. M. N. H. No. 24530. PARATYPES.—A. M. N. H. Nos. 24531-4. Collected July 4, 1926.

TYPE LOCALITY.—Komodo, 2500 feet altitude.

RANGE.—Known only from type locality.

DIAGNOSIS.—Very close to *O. monticola*: shoulder girdle similar; differing in smaller size (max. 18.5 mm.); feebly developed digital disks; a dark lateral band; slightly longer legs, heel reaching hind border of eye; a dorso-lateral line of warts.

DESCRIPTION.—A. M. N. H. No. 24530; tongue large, oval entire; snout short; rounded; canthus rostralis rounded; interorbital space broader than upper eyelid; tympanum feebly distinct, two-thirds the diameter of the eye; disks of fingers and toes very feebly developed; first finger much shorter than second; toes free; no subarticular tubercles; a very feebly developed inner metatarsal tubercle; the heel reaches the hind border of the eye; skin above with a few small warts; a line of elongate warts from eye more than halfway to groin; belly finely granular; above tan; warts marked or outlined with black; a fine dark mid-dorsal line and X-mark on the scapular region; sides below dorso-lateral glandular line darker; thighs indistinctly barred; length 16.5 mm. There is a cartilaginous procoracoid running from the base of the clavicle to the scapula.

The largest specimen, No. 14531, measured 18.5 mm.; the smallest, No. 24534, 12 mm.

These tiny frogs add a third species of *Oreophryne* to the Lesser Sunda fauna, and, together with the fact that the young of *O. monticola* have feeble disks, make the 7 mm. long *Microbatrachus pusillus* from the Aru Islands seem almost certainly the young of an *Oreophryne*.

The range on Komodo was the extreme peaks of the island, where there was a small region of cloud forest, probably not more than three acres in extent. If the frog should prove not to occur on peaks in Sumbawa or Flores, this would be one of the most restricted ranges known. They were hopping about on the floor of the forest, among the débris and the great rock-masses which gave this part of Komodo such an uncanny aspect, and which appearance was here heightened by the heavy coating of moss on everything.

I have named this frog in honor of Thomas Jefferson, author of the Declaration of Independence of the United States of America, which was signed on July 4.

***Kaloula baleata* (Müller)**

Two specimens from Komodo at 2000 feet. The first indication of the presence of frogs on Komodo was the finding of fragments of this animal in the stomachs of two tree-vipers, which were taken at night near the rock pools of the rapidly drying stream. Two specimens were finally found the night of July 2. The distribution of *K. baleata* and *K. pulchra* is extremely puzzling. Both seem to occur in Sumatra, Borneo, and Celebes, but in Java *baleata* is the only species, and it is likewise found on Komodo and on Sumba, while *pulchra* is found on Flores.

***Microhyla achatina* Boie**

Six adults and forty larvæ from Tjibodas. They were calling at night all the time (May 8-16) I was at Tjibodas. The call was a rattling note very like that of *Acris*.

***Microhyla annectens* Boulenger**

One hundred and fourteen adults and young from Tjibodas. I did not hear the call, and the breeding season was apparently over, for nearly half my specimens were tiny young, the smallest 8 mm. in length.

***Rana limnocharis* Boie**

Fifteen specimens: six from Buitenzorg, eight from Bali, and one from Suela on Lombok. The call, heard at Buitenzorg on the night of May 6, is a guttural croak.

***Rana cancrivora cancrivora* (Gravenhorst)**

Eighteen specimens: one from Buitenzorg, thirteen from Suela, and four from Bima on Sumbawa. The call is a trill, and was heard at Buitenzorg the night of May 7.

After careful consideration of Malcolm Smith's remarks (1927, Proc. Zoöl. Soc. London, p. 205, *et seq.*), I cannot find that my specimens from Lombok, Sumbawa or Wetar represent more than one form. I do find that Wetar specimens show the fold of skin along the outer toe in a rudimentary condition, and exhibit elongated warts rather than longitudinal ridges. The Bima specimens are transitional between the Javanese and Lombok ones and those from Wetar. I am therefore inclined, on the basis of my material, to regard *cancrivora* and *verruculosa* as vicarious races rather than as full species which may occur together.

***Rana cancrivora verruculosa* (Roux)**

Seven specimens from Uhak on the north coast of Wetar.

***Rana macrodon* Kuhl**

One specimen from Buitenzorg: we saw several which appeared to us remarkable on account of their ability to cross over the surface of a pond by a succession of leaps without ever sinking below the surface. They reminded both Mr. Burden and myself of the lizard *Basiliscus* of the American tropics, by this water-walking.

***Rana modesta* Boulenger**

A very large series of 268 transformed specimens and 35 tadpoles from Sembalun on Lombok at 3900 feet, and twenty-five tadpoles from near Suela on Lombok at 1300 feet. The largest frog in this series measured 63 mm. from snout to vent. The call was heard the last week of July, and may be rendered as "awk ek ek ek." The tadpoles of this species from Lombok differ from those described by Van Kampen (1923, Amphibia Indo-Australian Arch., p. 177) from an unstated locality, in having invariably three rows of horny teeth on the lower lip, and in both the muscular portion of the tail and the crests spotted with black.

***Rana kuhlii* Schlegel**

Seven adults and 72 tadpoles from Tjibodas. The tadpoles differ from those described by Smith (1917, Journ. Nat. Hist. Soc. Siam, (2) IV, p. 262) from Siam, in that his specimens had the inner upper row of horny teeth broadly interrupted while in mine this row is continuous; his had the outer row of lower teeth half the length of the inner, and the middle row nearly as long as the inner, while mine have the middle row half as long and the outer row one-fourth as long as the inner. In mine the markings on the tail are much more in the form of definite cross-bars than in his. Differences such as these in tadpoles of what are commonly considered the same species of frogs from different places in the East have been frequently noted in the papers of Smith, Annandale and Van Kampen, and probably the adults from different localities may well be scarcely different while the tadpoles are unlike. In these cases it is perhaps unwise to discriminate systematically between them; but there is little logical difference between these cases and those others in which the tadpoles are alike and the adults different, and in the latter there is general sanction for systematic discrimination.

***Rana microdisca* Böttger**

Thirteen transformed specimens and 49 tadpoles from Tjibodas. The tadpole of this species has not apparently been described.

Length of body about one and two-thirds times its width; tail 5 times as long as deep; nostril nearer eye than snout; eyes latero-superior, same distance apart as nostrils; spiracle nearer eye than vent; tail obtusely pointed, crests low, upper to base of tail; papillæ at sides of mouth and below; labial teeth $\frac{2}{3}$; inner upper row broadly interrupted, one-fourth width of outer; two inner lower rows equal, innermost narrowly interrupted; outer one-third length of the other two; brown, paler below; tail with black dots on muscular portion and on upper crest, lower crest colorless; length 29 mm.

***Rana elberti* Roux**

A small specimen (length 22 mm.) from Uhak on the north coast of Wetar seems to be the second known specimen of this species, described from a 48 mm. specimen from Iliwaki on the south coast of the same island.

***Rana florensis* Boulenger**

Eleven transformed specimens and seventy-two tadpoles from Sembalun (alt. 3900 ft.) on Lombok are considered to represent this species, described from Flores at an altitude of above 3000 feet. These speci-

mens were collected by Everett who also collected at high altitudes on Lombok and took there the types of *Oreophryne monticola*. It is of course quite possible that this frog occurs on both islands, but it is also possible that some mistake occurred and that the types of *florensis* were actually taken on Lombok. This seems to be the second time the species has been caught.

The tadpole has not been described, and in view of the fact that Van Kampen (*op. cit.*, p. 201) unites the species with *R. papua*, it may be emphasized that these tadpoles differ from his description of the tadpoles of *papua* from New Guinea and the Aru Islands in having the labial teeth $\frac{5}{3}$ instead of $2-\frac{1}{3}$.

Body length one and two-thirds times its width; tail twice as long as body and four times as long as deep; nostrilequidistant between eye and snout; eyes superior, interocular width equals internasal width; spiracle nearer posterior end of body than tip of snout; papillæ on sides of mouth and below; teeth $\frac{5}{3}$; all upper rows except outer interrupted, the second only narrowly so; lower rows nearly equal, the inner slightly interrupted; brown above, black below; tail lighter with a few dark spots; length 57 mm.

***Rana jerboa* (Günther)**

A small specimen from Tjibodas.

***Rana chalconota* (Schlegel)**

Three transformed specimens from Buitenzorg and 21 from Tjibodas, and 41 tadpoles from Tjibodas. The notes were heard at Tjibodas May 8-13. The call is a mewling or squeaking sound, rather cat-like or bird-like. While it was usually delivered from the water's edge, on at least one occasion a calling male was taken from a tree over six feet up, and a large female was on the same tree. On the night of May 12 a great many of them were congregated on the branches of an *Araucaria* tree where the branches dipped into the water of the lake. Next morning there was a floating film of eggs on the water at this spot. These observations do not corroborate nor wholly contradict those of the Sarasins in Ceylon, but at least show that if *chalconota* does lay its eggs out of water, they do not long remain there, and that the approximation to the habits of *Rhacophorus* is not exact.

***Rana erythræa* (Schlegel)**

Seven from Buitenzorg. I heard the call on the night of May 24. It was much like that of *chalconota*, but shorter and more bird-like.

***Rhacophorus leucomystax* (Kuhl)**

One specimen of the striped variety and two tadpoles from Tjibodas; eleven specimens of the unstriped variety from Sembalun on Lombok.

***Rhacophorus javanus* Boettger**

Fourteen specimens from Tjibodas, and twenty-nine tadpoles. The note is a croak, and was heard May 11–12. In life the colors are brown, with dark gray mottling; the concealed surfaces of the legs and the webs are bright orange; the dermal ridges are white. On one occasion three of these frogs were on a small dead branch above the water, and I watched them for some time, during which they were silent and immobile. Finally I caught them, to discover that one had not moved for so long that a spider had used him as part of the attachment for a web!

***Rhacophorus reinwardtii* (Boie)**

One specimen from Tjibodas. A faded specimen of this species is probably the basis for Ahl's new *R. barbouri* (1927, Sitz. Ges. nat. Fr., p. 45).

***Philautus aurifasciatus* (Schlegel)**

Twenty-two specimens from Tjibodas. Some of these are very small and recently transformed. The smallest measures only 6 mm. They were calling from trees and bushes in the woods, well away from water. The call was "ek ik," and the whole belly was involved in the vocal sac. I am inclined to consider that some *Philautus* at any rate may well represent a natural group, derived no doubt from *Rhacophorus*, but not necessarily to be merged with it. The character of the vomerines being edentulous may be variable and of little weight in some groups, but certainly the single species of *Philautus* I saw was quite different in facies from the three *Rhacophorus*, and it is more practical to keep any distinction which possibly separates natural groups until actual generic revision, species by species, is done. Then, and not until then, will the true generic characters become apparent; and until then there is no assurance that internal features are of any greater significance than external features.

DISCUSSION

The Amphibian fauna of the Lesser Sundas east of Wallace's Line now numbers 17 species, 7 of them restricted to the region. This is a higher percentage of endemism than is found in the lizards or the snakes and is obviously correlated with the lesser powers of dispersal of the

frogs. Of the endemics one is eastern (*Hyla everetti*), two is western, and four belong apparently to an older fauna, derived from the West, but now found chiefly in the Lesser Sundas, Celebes, and the Moluccas. Of the non-endemics one is eastern (*Hyla infrafronata*), one (*Rana modesta*) belongs to the older western fauna, and seven are modern western forms. Compared to the reptiles, the relative absence of eastern forms is very noticeable, as is the large element formed by the older western fauna. Within each of these faunal groupings the percentage of endemism is nearly the same as in each of the similar groups of snakes and lizards, and the higher total endemism among the frogs may be accounted for by the higher percentage of the middle fauna. The difficulty of migration into these islands from the East, seen in the snakes more than in the lizards, is still more marked in the frogs.

Of the total fauna of 17, 11 were taken, a slightly better showing than in the lizards, and much better success than we had with the snakes.

Twenty species were taken on Java, fourteen of them at Tjibodas.

The total herpetological collections of the Douglas Burden Expedition to the Island of Komodo number 1616 specimens, 73 species, and 6 subspecies.

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RESULTS OF THE DOUGLAS BURDEN EXPEDITION TO THE ISLAND OF KOMODO

V.—OBSERVATIONS ON THE HABITS AND DISTRIBUTION OF *VARANUS KOMODOENSIS* OUWENS

BY WILLIAM DOUGLAS BURDEN

In the first of this series of papers Dr. E. R. Dunn has discussed the distribution and relationships of the giant monitor, *Varanus komodoensis* Ouwens. I mentioned in my narratives (1927) of the trip which we made to Komodo and adjacent islands some of our observations on the habits of this species. The present paper represents a summary of our more significant observations, together with some comment on the factors controlling the distribution of *Varanus komodoensis*. These notes, although admittedly incomplete, are of interest in that they add a number of new facts to our existing knowledge of the largest species of lizard living today.

It is hoped that the following observations will be of use to future field students who may visit Komodo. There is much still to be learned about the habits of *Varanus komodoensis*. June and July are ideal months to visit Komodo. I have never known a more salubrious spot to live and work in.

Komodo Island, by an act of the Dutch Colonial Government, is a game preserve. Thanks to the Governor General of the Dutch East Indies, we were given permission to secure fifteen specimens.

DISTRIBUTION

Varanus komodoensis is now known from four islands: namely, Komodo, the adjacent islands of Rindja and Padar, and the western extremity of Flores. So restricted is the range of this great lizard that certain obvious questions arise: (1) Whence did *komodoensis* come? (2) By what route did the species reach these islands? (3) If the lizards were successful in crossing large water barriers, as it is evident they must have been, what factors now prevent them from extending their range?

The first question has been answered by Dr. Dunn (1927), who concludes that *komodoensis* is derived from Australia. The weight of evi-

dence seems to be conclusive but it cannot be reviewed here. As the second question has never before been touched on, I would like to suggest a possible migration route from Australia to Komodo.

To begin with, the Lesser Sunda Islands, built up by volcanism along the axis of the Sunda fold, are of fairly recent origin. The first of them appeared above sea-level in the Pliocene (cf. Brouwer, 1925). Some are still under construction. They have never been connected by land with Australia. In fact, the physiography of the sea-bottom, as determined by soundings, indicates that a geosynclinal trough trending east-west separates the Lesser Sundas from the Sahul Shelf. Many of the islands of this group, however, have been connected with each other, for transverse faulting of the great Sunda fold has been of frequent occurrence. There is evidence indicating that Rindja and Padar and Komodo were at one time all connected and that they have subsequently, through transverse faulting, become detached, but it is inconclusive. Be this as it may, since *Varanus salvator* has succeeded in working its way from Java, the entire length of the Lesser Sunda chain, there is no reason that *komodoensis* is not capable, in like manner, of bridging extensive water barriers.

A glance at Brouwer's map (1925) of the East Indies reveals the Sahul Shelf extending northwestward from Australia nearly to Timor and northward to and including the Aru Islands and New Guinea. This shelf was, during the Pleistocene glacial periods, a part of the Australian continent. Thus, in the Pleistocene, the jump from the northward limit of Australia to the island of Timor is with the prevailing southeasterly trade-winds a fairly easy gulf to bridge, when the various methods of accidental transportation are considered. From Timor, *komodoensis* could have made its way, step by step, along the old outer arc of volcanic islands to Sumba, just as *salvator* has made its way similarly along the newer Lesser Sunda Island arc from Java to Wetar. The next jump from Sumba to Komodo under the influence of the same southeasterly trade winds is no more difficult to bridge than the original Timor jump. Here, at least, is a tentative explanation which accounts for the curious manner in which *Varanus komodoensis* bisects the range of *salvator*. There is one criticism however, namely, that, as Dr. Dunn (1927) points out, *salvator* occurs on Sumba and that inasmuch as these two species seem to be mutually exclusive, *komodoensis* must have passed that point on its migration before *salvator* arrived. This, however, is pure speculation. The ecological relation between *salvator* and *komodoensis* on Flores is as yet undetermined. However, if *komodoensis* is found on Solor, the above route will have to be modified.

Now, as to the third question, why does *Varanus komodoensis* occur over such a very limited area? In consideration of what is known of other varanids, one is forced to the conclusion that there is a definite answer to the problem, that there are, so to speak, "limiting factors." It is these factors which we wish to determine. In order to facilitate this study, it will be well to record here the observations of the writer made during four weeks residence on Komodo, from June 9 to July 10, 1926. Until some hypothesis is offered to account for the facts, we must regard any observations as important whether or not they have an apparent bearing on the problem.

ENVIRONMENT

Komodo consists of a semi-arid, rather open, rugged country covered with alang-alang grass, *Imperata cylindrica*, stately gubdong or lontar palms, *Borassus flabelliformis*, and clumps of jungle into which *komodoensis* may retreat when danger threatens. The lizards were found both in the open country and in the jungle. So far as could be gathered from native descriptions, Rindja is strikingly like Komodo, as is also the only section of Flores in which these lizards are found. It is possible, therefore, that the restricted distribution of this beast is to be accounted for by the limits of a specific type of environment. Perhaps the western tip of Flores is the only section of that large island which affords suitable conditions for the survival of *Varanus komodoensis*, or, possibly the lizard has only recently established itself on Flores and has therefore not yet had time to extend its range. This is a matter for investigation. From the descriptions of De Rooij, it is evident that the western tip of Flores bears a striking resemblance to the typical Komodo landscape. It may be, therefore, that environmental factors are responsible for the restriction of range.

Padar, a small island lying east of Komodo, is for the most part an arid, upraised coral reef, and judging from the scarcity and size of the lizards (no large tracks were seen on the island) we may infer that the environment here is not wholly suitable. We have then, it would seem, an animal which dislikes both extreme aridity and dense jungle, but which seems rather to demand a combination of both.

RELATION TO OTHER ANIMALS AND FEEDING HABITS

On Komodo, *komodoensis* takes the place of the tiger of Asia and the lion of Africa as the formidable carnivore. Komodo is the local word for rat, yet strangely enough, we found no rats on the island. In certain sections of the East Indies, rats have been known to increase in propor-

tion to the decrease of *Varanus salvator*. Perhaps the Komodo rats have been wiped out by the lizards, since the island was named. As our traps yielded only one shrew, it is evident that the lizards do not subsist on small mammals. According to the evidence of stomach contents, and later confirmed by watching animals feeding on killed game, deer (*Cervus timoriensis*) and wild boar (*Sus vittatus*) form their staple diet, though birds and eggs no doubt often make an addition to the menu. As the giant monitors are plentiful on Komodo, we cannot imagine that enough deer and wild boar die a natural death to afford them a constant food supply. The logical conclusion then is that *Varanus komodoensis* deliberately attacks and kills these herbivores, a conclusion that is further supported by the fact that on one occasion I witnessed a large lizard that seemed to be stalking a wild boar. The boar eventually got wind of the approaching reptile and made off at top speed. The conclusion is supported yet again by a story related to me by the Dutch Resident of Bima, Sumbawa, in which he stated that a large lizard (the very one incidentally which eventually reached the Amsterdam Zoo) had, while chained to a tree on the outskirts of the town, jumped upon an old pony that strayed within reach. On asking to see the pony which had been attacked (in order to observe the scars), I was informed that the unfortunate beast had been so severely lacerated that it had to be shot.

According to the natives, wild horses are plentiful on the island of Rindja where they form the chief food supply of the giant lizard. I can hardly credit the tale but it is interesting, if true. On Padar, the lizards live almost entirely on turtle eggs which they dig up on the beaches. This was determined from the droppings which often contained undigested remains of egg shells. Further, the specimens we brought alive to New York ate hen eggs and Sachs (1927) reports the same for a specimen later brought to the Berlin Zoo.

In its relation to man, *komodoensis* is instinctively wary. This seems strange in view of the fact that Komodo has, until recently, been uninhabited. There was no indication that the giant monitors would attack man, but like all carnivores, they will fight desperately when cornered. As with other varanids, the tail is used as a weapon of defense. The lizards are obviously antagonistic toward each other. Two specimens of approximately equal size will, occasionally, fight for their prey. This observation, originally recorded by Ouwens' collectors is substantiated by Dr. Dunn (unpublished field notes).

They are so voracious that they will eat any rotten meat including that of their own kind. If one of their number is wounded, it is subject

to attack. But, although these beasts are cannibalistic, we do not know whether a large lizard will purposely hunt down and devour a small one. Judging, however, from the celerity with which small animals invariably made way for the larger ones, it looked as though they felt themselves to be too dainty a morsel to tempt fortune.

In watching from a blind, it is interesting to see how the feeding lizards used their teeth which are so well adapted to cutting and tearing (Fig. 1). The flattened, recurved teeth have sharp serrated edges.

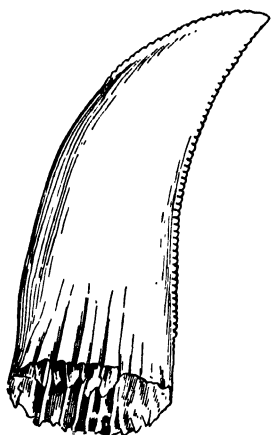


Fig. 1. Tooth of *Varanus komodoensis* Ouwens.

When a lizard bites, he rocks back and forth on braced legs throwing all his weight into each backward movement so that the teeth literally saw and cut their way through the hide of the prey. It is remarkable to see the ease with which a piece of tough hide can be cut out of the flank of a dead water-buffalo by these specialized, homodont teeth. When a piece of flesh has been detached through the see-sawing motion above described, the whole slab is gulped down regardless of size. As the morsel descends, the skin of the neck becomes greatly distended. Then, the beast licks his chops with his thin yellow tongue, rubs both sides of his face on the ground, as if to clean it, and lifts his head high, the better to observe the landscape. On one occasion, a lizard swallowed the entire hind quarters of a deer at one gulp—hoofs, legs, hams, vertebræ and all. The feeding process, though loathsome to watch (the writer frequently saw lizards run off with long strips of intestine dangling from their jaws) is, nevertheless, of great interest in that it probably gives us a fairly accurate picture of the way in which carnivorous dinosaurs devoured their prey. When disturbed at a feast, they were apt to vomit the contents of their stomach. One would hardly expect to find such an immediate nervous reflex in so low an order of vertebrates.

A most interesting problem, mentioned above, is to determine the relation between *komodoensis* and *salvator* in western Flores. It has been noted that these two predatory species, occupying as they do practically the same environmental niche, would seem to be mutually exclusive. What then is their relation on Flores? Do they invade each others' domain or is there an unseen boundary line between the habitat of the two species, and if so, why?

HOME RANGE OF THE INDIVIDUAL AND THE QUESTION OF DEAFNESS

There is no reason to believe that the home range of the individual lizard is in any way restricted on Komodo. The animals seem to wander all over the island up into the mountains and down again. Some specimens which we killed at sea-level contained the bones of wild buffalo. Buffalo do not occur on Komodo below two thousand feet. The nearest ones were certainly six or seven miles away so that, although the lizards no doubt prefer to return to their own burrows at nightfall, they are willing, on occasion at least, to wander afield. There was no indication that they prefer the warmer temperature of sea-level. Food supply rather than temperature seems to be the governing factor.

From the fact that these lizards did not usually appear at the baits which we set out for them till on toward ten o'clock in the morning when the sun was getting very warm, we accepted the general belief of the natives that they almost invariably seek an underground retreat at night. This may be due to the chill air that comes on rapidly after the sun goes down, or again, it may be that they are unable to detect approaching danger except by sight, and therefore prefer the safety of their burrows when visibility is low.

But as to the supposed deafness of *Varanus komodoensis*, there is more to be said. Mr. Aldegon reported that the beast is quite deaf, so much so, "that if care is taken that the animal does not see the hunter, the latter may make as much noise as he pleases without the animal being aware of his presence." This observation has been confirmed by subsequent observers, *i.e.*, the collectors sent to Komodo by Ouwens and by Dr. Dunn and myself. We would frequently sit chatting and laughing in a boma watching lizards not twenty yards away that were wholly unaware of our presence. On several occasions we shouted but the shouts had no effect and we concluded, therefore, that Mr. Aldegon was correct. Recently, a letter from Miss Joan B. Procter of the London Zoo, to whom I had written for information concerning the pair of *Varanus komodoensis* now residing at the New Reptile House there, says: "and they certainly are not deaf." When in their cave they have been known to come out when the keeper calls and obviously to pay attention to his voice when he speaks to them. And she concludes, "I think there is no question whatever that they can hear quite as well as other large *Varanus*." "On the other hand," she says, "in common with many of the larger and more powerful species, they do not always bother to pay attention to sounds and will frequently sit with a wooden expression when noises are made for experimental purposes." I wonder why, on Komodo,

the lizards should have been so very wary of the sight of man and so wholly indifferent to the sound of his voice. I do not feel that the question of their hearing is settled as yet. It is possible that the small black eyes which are sunk beneath projecting supra-orbital bones are so acute that *Varanus komodoensis* relies on them entirely to detect danger.

The long, bifurcated tongue is used as a sensory organ, but we know nothing more concerning its specific function.

NUMBERS AND DIMENSIONS

Komodo island is about twenty-two miles long by twelve in width. As our operations were restricted to the general region adjacent to Sawa Bay and from there to the summit of the island, I can say nothing about the southern portion which was never visited. The natives in the convict settlement of Sawa Bay (the only inhabitants of this island) could give us no reliable information, but it is obvious that, if game is plentiful on the southern half of the island, the lizards must be equally abundant there, where they have never been molested by man. Any estimate of the actual numbers on the island would be mere guesswork. Suffice it to say that I saw with my own eyes approximately fifty different lizards, at least ten of which were full-grown beasts. One can frequently recognize individuals. Where such recognition was possible, I have of course excluded them from the count. In the same length of time, Dr. Dunn saw fifty-four.

Whether at any time the lizards were much more plentiful than they are now is doubtful. As the island today is full of game, the lizards cannot ever have had a much greater food supply.

Recently, trappers and poachers have bagged a good many skins but, owing to the bony plates or osteoderms, the hides have no commercial value. Moreover, as the Dutch Colonial Government has had the wisdom to make of the island a game preserve, poachers will be dealt with severely.

A word as to size. The largest male which we secured measured 2.765 meters, approximately 9 feet, 2 inches; the largest female 6 feet, 6 inches. As Dr. Dunn (1927) has pointed out, it would seem after an examination of no less than 73 specimens that the reports published by Ouwens as emanating from Messrs. Aldegond and Koch, in which it was stated that the former had shot some specimens between 6 and 7 meters in length, are utterly inaccurate. The report that Sergeant Becker killed one of 4 meters is also unsupported by material evidence. Further,

Sachs (1927, p. 455) quotes Becker in a recent publication as saying that he never killed or saw a specimen over 3.60 meters. It is believed therefore that these reports can be dispensed with. Sachs, however, stated that a specimen of *komodoensis* brought to Senckenberg Museum measured 3 meters, in spite of an estimated loss of some 25 cm. of tail. He does not state, however, that these measurements were taken before the animal was skinned. So much depends on how an animal is measured that I feel that more details are necessary before this record measurement can be accepted.

The weight of a half-starved eight-foot specimen at the Zoo when it finally died was a hundred pounds.

COLORATION, MOVEMENT, AND POSTURE

The color of *Varanus komodoensis* Ouwens describes as being a dark brown. As seen in the open, the animal appears to be rather a greenish black, a color which stands out conspicuously against a green or light-brown background. It is rather by their actions, habits and poses that the beasts protect themselves. When traveling in the open grass country, they keep their heads close to the ground, and stride along in a most ungainly fashion, the head swinging heavily from side to side, the body twisting snakily, the tip of the tail usually dragging a short distance from the tip but sometimes held rigidly off the ground. This walk was so characteristic that we used to refer to it as the "Komodo walk." It can only be described as slow, deliberate and ponderous. There is a lot of lost motion and the movements are ugly. This is to be accounted for by the angle at which the humerus and femur bones project laterally from the body—a disadvantageous angle which with the evolution of mammals has been completely overcome. When running, the awkward gate seems to be smoothed out somewhat as the lizard skims along flipping its feet around to the side and covering the ground at a pace which I do not believe could be equalled by man. When the beast stops to look about, it lifts its head slowly above the grass and then for some time remains perfectly motionless. It is then that the monitor will observe the slightest movement in the landscape. If the hunter blunders into view, *komodoensis* studies him attentively, then ducks out of sight into the grass and slithers away to be seen no more.

On just two occasions I saw a lizard sit back on its hind legs and tail, its forelegs dangling at its side, as if trying to lift its head high to get a better view. In this pose there was a striking though superficial resemblance to certain dinosaur restorations.

Dr. Dunn observed two young lizards up in trees. The ability to climb doubtless enables a young specimen to secure birds' eggs before it is strong enough to pull down larger game.

SWIMMING HABITS

As swimmers the dragon lizards cannot be accounted more than moderately proficient. Although they show no aversion to water and will take to it readily, their movements, when in water, are awkward. Of five that we released from a cage on the beach of Telok Sawa, three took to the water and two raced back into the jungle. Of the three that entered the water, one male swam out into the bay and disappeared. He carried his head well above the waves so that he resembled paintings of mosasaurs. The other two lizards remained entirely submerged for a full two minutes and then appeared about seventy yards off, having swum that distance under water. When pursued in a boat they will, instead of struggling and trying to swim off, lie motionless, as if playing dead, with their heads beneath the water and their forelegs up over their backs. Where was this instinct developed and what is its significance? Occasionally, when crowded, they make a few feeble efforts with their tails. On leaving these two to their own devices, they soon swam down along the beach for about a mile and then waddled off into the jungle.

BURROWS

Two types of burrows predominate: those excavated under the roots of trees in the steep-faced banks of stream-made gulleys and those under rocks and large boulders. The former are usually found in the jungle, whereas the latter, occurring as they do in the open country, are frequently accompanied by a level sandy spot which is undoubtedly used for sun baths. Occasionally, these bare, sandy places are far removed from any burrows. I never observed a lizard taking a sun bath, but Dr. Dunn succeeded in sneaking up behind a rock and poking one with his rifle while the beast was basking. Typical basking places were seen only at high altitudes. This suggests that only the chilled lizards have the habit of basking in the same spot for long periods. Dr. Dunn noted that all the burrows observed by him faced the west. This would seem to be an adaptation for catching the rays of the hot afternoon sun. A few of the burrows found by Dr. Dunn in open fields were not under rocks. Hence the lizards exhibit a certain variety of taste in selecting their den sites.

SUMMARY

(1) *Varanus komodoensis* reached Komodo by flotsam-jetsam methods from Australia via Timor and Sumba during the Pleistocene.

(2) The species frequents open woodlands.

(3) It feeds on deer, pig, and water-buffalo, but may take birds or eggs.

(4) Its teeth are blade-like, recurved, and with sawtooth edges. These are very effective in cutting through tough hides.

(5) *V. komodoensis* avoids man but reacts only to visual stimuli. This suggests that the species is deaf.

(6) The species is abundant on Komodo, one observer recording fifty or over in four weeks' time.

(7) Food supply rather than temperature controls the distribution of the individuals on the island.

(8) Young individuals can climb trees, adults are terrestrial and walk with the whole body and all but a spot near the tip of the tail well off the ground.

(9) Experiments demonstrate that the species will take voluntarily to the sea. It swims clumsily but for long periods with success.

(10) Burrows are either under roots in the woods or under rocks in the open. They are rarely dug in open fields at a distance from rocks or other cover.

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59.9 (51)

NEW ASIATIC MAMMALS¹

BY GLOVER M. ALLEN

In the course of identifying the small mammals collected by the Asiatic Expeditions of The American Museum of Natural History in recent years, the following new forms have been found, which seem worthy of description.

Soricidæ***Crocidura lar*, new species**

TYPE.—Male, skin only, No. 59940, American Museum of Natural History, from Tsagan Nor, Mongolia. August 3, 1922. Third Asiatic Expedition.

DESCRIPTION.—A very small, pale species, with relatively short tail.

Upper surface of body and tail a very pale grayish brown, about "wood brown" of Ridgway (1912), the hairs dark slaty at their bases, then minutely ringed with gray, and tipped with pale brown. The gray rings showing through give a minutely grizzled effect and heighten the pallor of the upper side. Under surface of snout and tail, the entire chin and the backs of fore and hind feet white to the roots of the hairs. The rest of the under side of the body has the hairs slaty gray at the base tipped with white, so that the entire belly looks dull white. The tail is well clothed with short hair forming a small pencil, and is rather sharply bicolor; it has the numerous scattered bristles projecting conspicuously throughout its length.

SKULL.—Unfortunately the skull cannot now be found.

MEASUREMENTS.—The collector's measurements are: head and body, 60 mm.; tail, 29; hind foot, 12; ear, 8.

The discovery of a species of this genus in the Gobi Desert far beyond its previously known northward range in this part of Asia is very interesting. That the species is rare there is evident from the fact that with much trapping no other specimens were secured. This individual was caught in one of the tents into which it came one night. Although the skull is not available for study, the species seems so distinct in its pale desert coloration, small size, and short tail, scarcely twice the length of the hind foot, that I have no hesitation in naming it.

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 80.

Rhinolophidæ***Rhinolophus blythi parvus*, new subspecies**

TYPE.—Adult, skin and skull, No. 58465, American Museum of Natural History, from Nodoo, island of Hainan, China. December 8, 1922. Clifford H. Pope, collector; Third Asiatic Expedition.

DESCRIPTION.—Structurally like *R. b. szechwanus* of western China and *R. b. calidus* of southeastern China, but differing from both in its rich russet or darker brown coloring.

Color above in the red phase, nearly "russet" (Ridgway). The individual hairs over the back are pale ochraceous at their bases, deepening to a distinct russet tip about 2 mm. in length. Scattered among these are hairs with minute blackish tips, producing a darkening of the surface. On the sides of the head and on the neck, chest and mid-ventral area, the color is clearer, brighter russet; the throat is paler, pinkish buff. In the axillar area, ventrally, is a well-defined dusky area. Specimens in the brown phase are Mars brown, paling to the roots of the hairs, above; below, drab washed with chestnut at the sides.

SKULL.—The cochleæ are very large, nearly meeting in the midline so that the basioccipital is very much narrowed. There is a well-defined sagittal crest, branching anteriorly to form a ridge over each orbit, with a slight depression between. The first small upper premolar stands quite in the tooth row; while in the lower jaw the minute middle premolar of the type specimen stands in the row, but in other specimens may be partly external to it.

MEASUREMENTS.—In the type the forearm measures 36.3 mm.; third metacarpal, 27; fourth metacarpal, 28; fifth metacarpal, 27.6; tibia, 13.5; foot, 7.

The skull measures: greatest length, 16.5; basal length, 13.3; palatal length, 5.4; palatal bridge, 1.7; zygomatic width, 7.5; mastoid width, 7.7; width outside molars, 5.7; upper cheek teeth (canine to last molar), 5.7; lower cheek teeth (canine to last molar), 6.0.

Among the specimens secured, a bright, tawny phase is the more common, while a deep-brownish phase is also represented. In its brighter, more intense coloring it forms a marked contrast to the dull, gray-colored *R. b. szechwanus* in which the bases of the dorsal hairs are whitish, their tips drab, the belly drab. In *R. b. calidus* of eastern China the color becomes slightly more buffy but in this race from Hainan it is strikingly redder, even to the bases of the hairs. A series of over fifteen skins collected by Mr. Clifford H. Pope shows much uniformity of tint; but the dull-colored, grayish immature specimens are about as bright as adults of *R. b. calidus*.

In the dark or brownish phase this race resembles the two others mentioned, but is a much darker brown. The immature individuals of the series are similar, and it is possible that these brown adults are in reality not fully mature.

***Rhinolophus lanosus spurcus*, new subspecies**

TYPE.—Adult male, skin and skull, No. 58444, American Museum of Natural History, from Nodda, island of Hainan, China. December 4, 1922. Clifford H. Pope, collector; Third Asiatic Expedition.

DESCRIPTION.—A large, woolly-haired species with the external proportions as in typical *R. lanosus* of Fukien, China, but the skull much larger and the fur more sooty brown.

Andersen described *R. lanosus* as a member of the *philippinensis* group, with the base of the central nose-leaf forming wing-like lateral expansions. The fur is long and woolly, somewhat wavy, of a dull chocolate-brown above and below, tipped minutely with gray, giving a slightly frosted effect. In *R. lanosus* from Fukien, the color is a slightly richer brown.

SKULL.—The skull is decidedly larger than that of *R. lanosus*. The supraorbital ridges in both meet to form a prominent sagittal crest and cut off anteriorly a triangular depression between the orbits. The parietal area shows a curious pitting of the surface of the bone. The upper small premolar is quite in the tooth row but the lower one is partly external, so that it separates the two larger premolars, whereas in the Fukien race it is smaller and more to the exterior, allowing the two large premolars to meet.

MEASUREMENTS.—No collector's measurements accompany the specimens. The forearm measures 70 and 71 mm. in the type and a second male respectively. Third metacarpal of type, 44.7 mm.; fourth metacarpal, 53.2; fifth metacarpal, 54.2; tibia, 36; foot, 18.

The skull measurements of the type follow and, in parenthesis after each, those of an adult male from Fukien: greatest length, occiput to front of canine, 31.3 (28.4); foramen magnum to front of canine, 25.2 (23.0); palatal notch to front of canine, 9.6 (9.2); zygomatic width, 15.5 (13.2); mastoid width, 13.5 (12.8); width across molars, 10.4 (10.3); palatal bridge, 5.0 (4.8); upper cheek teeth, 11.3 (10.7); lower cheek teeth, canine to back of last molar, 12.0 (11.1); mandible from condyle to base of incisors, 21.5 (20.0).

This large woolly-haired species was originally described from Fukien Province, China, whence a small series was later obtained by Dr. Roy Chapman Andrews and Rev. H. R. Caldwell. The skull measurements of the type of *R. lanosus* agree almost exactly with those of a male from Yenping, Fukien, and are thus considerably smaller than those of the Hainan specimens, although the external dimensions are practically the same. Mr. Clifford H. Pope, who secured these bats, writes that they are rare. The first one was found in a prospector's shaft in woods. This tunnel was about fifteen feet deep, slanting, and not completely dark. A second bat was started but not secured in another similar shaft. A third was taken in another tunnel in woods. In each case the solitary bat was the only inhabitant of the cave and hung from roots in the ceiling.

Hipposideridæ***Cœlops sinicus*, new species**

TYPE.—Adult female, skin No. 84893, and skull No. 84388, American Museum of Natural History, from a cave two miles northeast of Wanhshien, Szechwan, China. February 26, 1926. Collected by Walter Granger; Third Asiatic Expedition.

DESCRIPTION.—Related to *Cœlops frithii* Blyth but smaller with a different coloring, and without a space between lower outer incisor and canine.

The pelage is long, dense and woolly, about 11 mm. in length on the back. The hairs, instead of being "shining brown" above and below, with pale bases, as described in *C. frithii* from Bengal, are blackish for the proximal two-thirds, with the terminal third indistinctly brown, nearly "sepia" of Ridgway (1912). The lower surfaces are similarly blackish at the bases of the hairs, then minutely brownish, tipped with gray, producing an indistinctly tricolor effect on close inspection. The membranes and the large translucent ears are smoke-gray.

In the structure of its remarkable nose-leaves, the specimen agrees closely with *C. frithii* as figured by Dobson. The horseshoe and the median erect process posterior to the nostrils are thickly clothed with short stiff hairs, while longer hairs arising from the sides of the nose-leaves behind the horseshoe form a well-defined fringe. On each side are six longer, shining hairs, probably sensory, one from back of the anterior edge of the main leaf of the horseshoe, three along its lateral edge, and two erect hairs from the face of the raised ridge behind the nostrils.

The wing in this genus is peculiar in the shortness of the third finger and the length of the fifth. The thumb has a very long metacarpal and short phalanx (7: 1.6 mm.), the former wholly involved in the propatagium; the second digit has no phalanges, and its metacarpal is minutely longer than the combined metacarpal and first phalanx of the third digit. The latter is the longest digit due to the great length of its second phalanx, for its metacarpal and first phalanx are less than those of the fourth or the fifth digits. The fourth finger is shorter than the third or fifth. The wing membrane arises from the metatarsus at the base of the toes. The calcaneum is well developed, as long as the toes, and serves to spread the interfemoral membrane which is deeply emarginate to within about 6 mm. of the body in the dried skin, and has its free border thinly fringed with short hairs.

SKULL.—The skull, compared with that of *Hipposideros gentilis*, is remarkable for its delicate structure, with a nearly globular brain-case and very narrow inter-orbital constriction, to which the sharp sagittal crest is confined. The frontal shield is nearly flat, its dorsal surface inclined at a sharp angle to the plane of the tooth row, and its anterior swellings but little raised above the general level on each side. The peculiar prolongation of the premaxillæ and maxillæ combine to give the skull a profile that tapers nearly to a point in front.

The upper canine is noticeably compressed, with a prominent secondary cusp, projecting about half-way on the posterior cutting edge. The anterior small upper premolar is distinctly crowded to the outer side of the tooth row, but the second premolar does not quite reach the base of the canine. In the lower jaw the outer incisor abuts closely against the canine instead of being separated by a space as in *C. frithii*, and in height barely exceeds the cingulum of the canine. The anterior lower premolar is slightly to the outer side of the tooth row. All the lower cheek teeth are much compressed and blade-like.

MEASUREMENTS.—The collector's measurements are: head and body, about 38 mm.; ear, 16; spread of wings, 232. The forearm measures 35.5 mm.; thumb, metacarpal, 7; phalanx, 1.6; second finger, metacarpal, 35 (the bone is slightly bowed in the skin); third finger, metacarpal, 26.3; first phalanx, 7; second phalanx (across the chord of the bone as bent in drying), 22; fourth finger, metacarpal, 28.6; first phalanx, 9.0; second phalanx, 10.2; fifth finger, metacarpal, 30.5; first phalanx, 10.1; second phalanx, 12.0; tibia, 16.4; hind foot, 8; calcar, 5.

Skull: greatest length, 17.0; basal length, 13.5; condyle to front of canine, 15.1; palatal length, 6.2; median length of premaxillaries, 4.0; zygomatic width, 7.8; mastoid width, 8.2; interorbital constriction, 1.8; width of frontal shield, 3.9; width outside molars, 5.8; front of canine to back of last upper molar, 6.4; lower tooth row, incisor to back of last molar, 6.8.

Of this rare genus there is at present recognized but two species, *Cælops frithii*, of Bengal and Java and *C. robinsoni* of Pahang, a slightly smaller replica of it. The single individual on which the new species is based extends the known range of the genus well into China. While its relationship to the Indian species may eventually prove to be closer than indicated, its smaller size and different style of coloring seem to proclaim its specific distinctness. The highly modified upper canines with their strong forward projection, prominent secondary cusp, and compressed cutting edge, the deeply emarginate tail membrane, the peculiar nose-leaves and enlarged ears may indicate some unusual feeding habit. In contrast to its relatives *Hipposideros*, *Cælops* seems to be solitary in habits. The specimen described was secured by Mr. Walter Granger from a "warm-air" cave, in which it was evidently hibernating.

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THE WHALE SHARK, *RHINEODON TYPUS* NEAR HAVANA HARBOR, CUBA THE FIFTH RECORD FROM THE STRAITS OF FLORIDA

BY E. W. GUDGER AND W. H. HOFFMANN¹

This specimen of the whale shark was taken on November 20, 1927, at Jaimanitas, a fishing village in the suburbs of Havana, about five miles west of the mouth of the harbor. Figure 1 shows the great fish and its captors shortly after it was drawn to the beach and left partly dry by the ebbing of the tide. Unfortunately the picture was not made for scientific purposes, and the large number of men sitting on the back of the fish obscure much that one would like to see. However, attention may be called to the wide head, the terminal mouth, the eye just back of the corner of the mouth, the gill slits, and the spots on the head and shoulder region. One also gets an idea of the enormous size of the fish even in its collapsed state (due to its lack of bony parts).

The fish roughly speaking was 32 feet in length and 18 in girth, and its weight was estimated at 9 tons. The skin was fully 2 inches thick and its weight is said to have been a ton. The weight of the liver is given as 900 pounds and that of the heart as 43 pounds. The body of the fish was about 6 feet deep, and the "small" of the tail was so large that a tall man could barely encircle it with both arms. The caudal fin was rather lunate and fairly symmetrical, the upper lobe being the longer. The depth of the caudal from tip to tip was about 6 feet. The anterior edge of the fin was thick and fleshy, the hinder thin and membranous. The anterior dorsal fin was about 32 inches high. These points may be fairly well seen in Fig. 2, a photograph made of the fish left stranded on the beach by the fallen tide. Exposure to sun and air had already badly affected the skin. Still one can make out the general form of the body proper, the spots, the longitudinal keels, the two dorsal fins and the caudal.

This specimen of the whale shark was a male. The claspers were about two feet long and as large as a man's leg at the knee. The adjacent

¹Dr. Hoffman is associated with the Finlay Laboratory, Havana, Cuba.

pelvic fins were about 16 inches long. The pectoral fins at the base were about 24 inches broad, while their length was about 48 inches. The small eye was placed almost directly behind the angle of the mouth, and at about an equal distance back of this was the relatively minute spiracle.

The color of the fresh specimen was a dark brown approaching black above, while the ventral surface was greenish gray. A line running over the back and connecting the median points of the bases of the pectorals divides the markings into two distinct groups. Forward of this line there



Fig. 1. The Havana whale shark partly out of water, as seen in left front-lateral view. Note the harpoon in the left gill region.

were about 30 to 40 vertical rows (the spots are rather irregularly placed and the rows hard to count) of about 20 spots each. The spots grow smaller and more crowded toward the mouth. Back of the line noted, and above the mid-lateral region of the body were 34 vertical rows of three spots each—the spots about double the size of a silver dollar. No vertical lines separating the rows of spots were noted. For these points see Fig. 1.

These rows of spots, taken in connection with the three longitudinal keels extending back from the shoulder region to a point behind the

second dorsal (Fig. 2), give the sides of the fish a characteristic checkered appearance which leads to its local name "pez dama." Now pez means fish, and dama ordinarily lady; hence, the lady-fish. But dama also means checker-board and hence *Rhineodon* is rather appropriately called "pez dama," the checker-board fish. The dark blocked-off sections of skin with their large round white spots certainly do resemble the squares of a checker-board with the draughts in the center of each. This effect would be heightened if the vertical bars found on other specimens were present—as they presumably were at the time of capture. In keeping with the idea implied in the name, when the fish was moved to the



Fig. 2. Right lateral view of the whale shark showing the blunt head, the median fins, the lateral keels, and the upper lobe of the caudal.

center of Havana for exhibition (as set out below), on the placard outside the owner had painted the checker-board tablet on which the game is played.

The mouth is wide and terminal, and the tooth-bands are found immediately inside it as though they were a part of the lips. For this see Fig. 3, which shows the tooth-band in the lower jaw. Each band was about 31 inches long by 2.25 inches wide. The teeth were arranged in about 20 longitudinal (right-left) rows, and in about 300 transverse (front-back) rows. Thus there were approximately 6000 teeth in each jaw, those near the angles of the jaws being very minute. The longest (those in the middle) were only about $\frac{1}{8}$ of an inch high. The teeth in these card-like bands are all set pointing slightly backward, and,

when the jaws are nearly closed, serve to retain the food, but not to cut or rend it.

The fish was crudely but rather effectively mounted on some kind of a framework or manikin, and presented a huge whale-like appearance as may be seen in Fig. 4. The spots, which had faded in process of time, were painted in none too artistically, and the whole skin was varnished. At first the fish was exhibited in a tent in the suburb where it was captured. Later it was carried to various parts of Havana, and still later was exhibited for some time in a large room near the center of the city. Thus



Fig. 3. Nearly head-on view of *Rhineodon* showing the broad collapsed body, and the cavernous mouth with the tooth band in the lower jaw. The harpoon shown is the one used in its capture.

mounted and exhibited, the fish attracted considerable attention and netted its captor and owner a comfortable sum. Later it was removed to some other part of the island and all trace of it has been lost.

The fish was sluggish and stupid, making no demonstration even when the boat was "nosed" up against him. He was harpooned in the left gill region (see Fig. 1) and, some of the branchial vessels having been cut, he bled profusely. Even after being harpooned he offered practically no resistance, merely dragging the boat around with him. Finally he became so weakened by loss of blood that he was towed to shore, some 20

hours after the boat was made fast to him. Here, after being stranded, he lived several hours longer. The non-resistant behavior of this specimen tallies exactly with that of the other 3 fishes taken in the Straits of Florida or in waters immediately contiguous, as I have noted in recording these other captures.¹ These data were obtained from the head fisherman of the crew that captured this *Rhineodon*. This man (Miguel by name), in all the interviews with him, left the impression of being entirely trustworthy. He reports that the fish harpooned had been seen in the vicinity for two or three days before being captured. Furthermore, there are various rumors that four or five other huge fish had also been seen, but these accounts do not speak of any spots, and we doubt if these were whale sharks. However, the head fisherman referred to says that on January 20, 1928, he saw another huge spotted fish and harpooned it, and that while it too offered little or no resistance it finally got away. It is possible that this might have been the mate of the captured *Rhineodon*.

A possible explanation of this occurrence of the whale shark on the northwest coast of Cuba is to be found in the fact that in early winter small fishes (the head fisherman called them "sardines") come inshore from the Gulf Stream in vast shoals. Possibly *Rhineodon* normally feeds on these. At any rate the specimen captured was reported as feeding on them when taken (his mouth being literally full of them). Unfortunately his stomach was not opened until after several days, when all its contents had gone to pieces. However, this reported feeding habit tallies exactly with information sent by a scientific man in the Seychelles Islands, in the western Indian Ocean, that *Rhineodon* comes inshore there at that season of the year when vast shoals of a certain small fish on which it feeds come into shallow water.

This is the fifth whale shark taken in or near the Straits of Florida. The first specimen came ashore dead at Ormond Beach, in 1902. The second, was captured by Captain Charles Thompson of Miami, Florida, and Mr. Charles T. Brooks of Cleveland, Ohio, at Knight's Key, in May, 1912. The third was taken in the Bay of Florida by Dr. H. Schlegel and others on June 10, 1919. The fourth was taken by Captain Newton Knowles of Miami and Mr. Claude Nolan of Jacksonville, at Marathon, 16 miles below Long Key, on June 9, 1923.

¹Gudger, E. W., 1913, 'A Second Capture of the Whale Shark, *Rhineodon typus*, in Florida Waters,' Science, XXXVIII, p. 270; 1920, 'A Third Capture on the Florida Coast of the Whale Shark, *Rhineodon typus*,' Science, LII, pp. 191-192; 1923, 'A Fourth Capture in Florida Waters of the Whale Shark,' Science, LVIII, pp. 180-181.

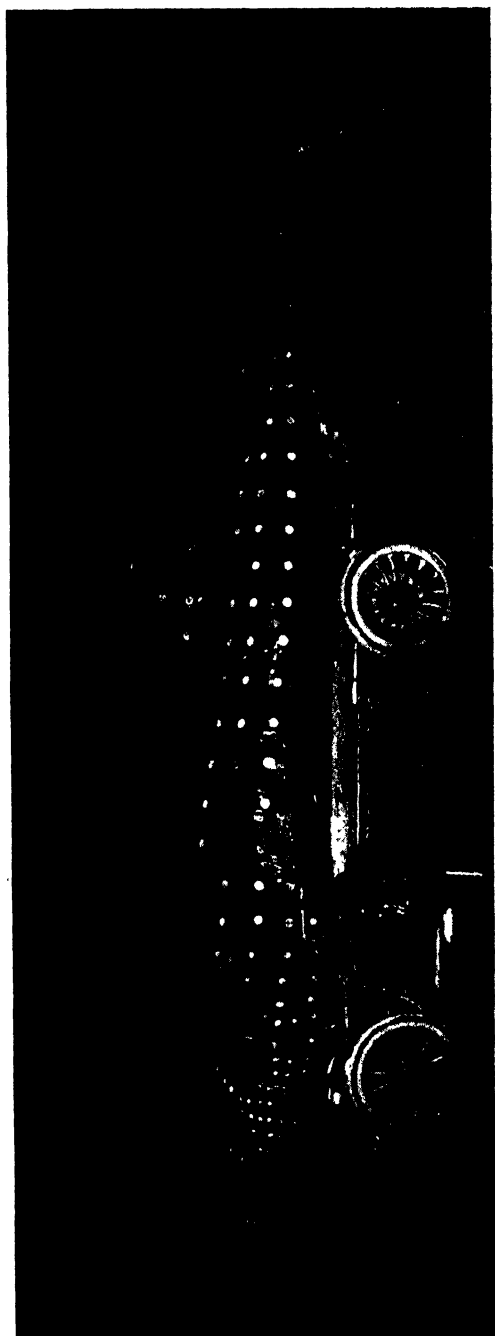


Fig. 4. The mounted whale shark on a truck. The mounting is crudely done as are the hand-painted spots.

The present specimen is the fifth for this region. It was 32 feet long; number 4 was also 32 feet long; number 3 was 31 feet in length; number 2, the largest (38 feet), and number 1 the smallest (evidently a young one), 18 feet. These facts lead to the tentative conclusion that the normal length of adult whale sharks in this region is somewhere between 30 and 40 feet. This estimate falls in line with the sizes given of other *Rhineodons* in various parts of the world. The longest measured specimen—45 feet—was taken in the western Indian Ocean (Seychelles Islands).

Whether the fish is indigenous to these immediate waters cannot be said. Data at hand, but not from scientific sources, lead us to conclude that the fish is to be found in the Straits of Yucatan and farther east about Trinidad. All the other specimens from the Straits of Florida have been captured in the summer, and it has been thought that they were summer migrants. The present capture, however, would seem to negative this conclusion.

Two other captures of whale sharks in the Atlantic have been recorded and curiously enough both have been taken in the same manner—by being impaled on the bow of a steamer. One was taken on May 19, 1923, near the Abrolhos Light off the southern coast of Brazil, the other in the northern part of the Gulf of Guinea on July 6, 1924.¹ In addition there is a report by George Bennett in 1834 of two large "bone-sharks" seen near the Azores in 1831. These were not close enough for the markings to be made out, and it is a question whether they were *Rhineodon typus* or *Cetorhinus maximus*—both fishes being sometimes called "bone-shark" because of their gill-raker structure.

Thus, while the whale shark has been taken on both the east and west sides of the Atlantic, and while there are newspaper and other unconfirmed reports of its occurrence near Trinidad and off the Yucatan reefs, yet we must go to the Straits of Florida for the greatest number of authentic records in the western Atlantic. Here it has been taken five times, and either the fish or photographs of it have been seen and put on record.

¹Gudger, E. W., 1923, 'An Extraordinary Capture of the Giant Shark, *Rhineodon typus*,' *Natural History*, XXIII, pp. 62-63, Fig.; 1927, 'A Second Whale Shark, *Rhineodon typus*, Impaled on the Bow of a Steamship,' *Bulletin New York Zoological Society*, XXX, pp. 76-77, Fig.

59.7(66.2)

FISHES FROM THE WHITE NILE COLLECTED BY THE
TAYLOR EXPEDITION OF 1927

A DISCUSSION OF THE FRESH-WATER FISH FAUNÆ OF AFRICA

BY J. T. NICHOLS

The first collection of Nile fishes which The American Museum of Natural History has obtained directly from the field are those of the Taylor Sudan Expedition of 1927 (H. E. Anthony, collector). They comprise about 285 specimens, taken at some 16 localities as follows: Akona, Bahr-el Arab, South of El Dueim, Gemeiza, Bahr-el-Ghazal, Jebelein, 125 miles south of Khartoum, Kosti, South of Malakal, Mongalla, Musran Island, Lake No, Renk, Shambe, Tonga Island, Bahr-el-Zeraf.

Although several of the species were previously unrepresented in the Museum, and some of the forms are of peculiar interest, all are well known. They are listed below with approximate numbers, size, and number of localities where taken, for such index as they may furnish to the character of the Nile fauna. As has been pointed out in discussing the fishes of Angola,¹ representative collections may prove better criteria for drawing faunal lines than more complete local lists. A representative collection is a substitute for actual study of this problem in the field, frequently not practicable.

Osteoglossids

1. **Heterotis niloticus** (CUVIER); 3 specimens; 480-580 mm. standard length; 1 locality.

Mormyrids

2. **Petrocephalus bane** (LACÉPÈDE); 7 specimens; 88-153 mm. standard length; 3 localities.
3. **Gnathonemus cyprinoides** (LINNÆUS); 1 specimen; 155 mm. standard length; 1 locality.
4. **Hyperopisus bebe** (LACÉPÈDE); 2 specimens; 210-256 mm. standard length; 1 locality.
5. **Marcusenius petherici** BOULENGER; 1 specimen; 120 mm. standard length; 1 locality.

¹Nichols and Boulton, 1927, Amer. Mus. Novitates, No. 264, pp. 1-2.

Characins

6. **Hydrocyon forskalii** CUVIER; 2 specimens; 190–206 mm. standard length; 1 locality.
7. **Hydrocyon lineatus** BLEEKER; 5 specimens; 165–242 mm. standard length; 3 localities.
8. **Hydrocyon brevis** GÜNTHER; 1 specimen; 350 mm. standard length; 1 locality.
9. **Alestes dentex** (LINNÆUS); 14 specimens; 98–235 mm. standard length; 7 localities.
10. **Alestes baremose** (JOANNIS); 3 specimens; 110–190 mm. standard length; 3 localities.
11. **Alestes nurse** (RÜPPELL); 50 specimens; 70–140 mm. standard length; 8 localities.
12. **Alestes macrolepidotus** (CUVIER AND VALENCIENNES); 15 specimens; 90–430 mm. standard length; 3 localities.
13. **Ichthyoborus besse** (JOANNIS); 1 specimen; 160 mm. standard length; 1 locality.
14. **Distichodus niloticus** (LINNÆUS); 24 specimens; 90–380 mm. standard length; 2 localities.
15. **Citharinus citharus** (GEOFFROY); 33 specimens; 95–310 mm. standard length; 4 localities.

Catfishes

16. **Clarias anguillaris** (LINNÆUS); 1 specimen; 440 mm. standard length; 1 locality.
17. **Schilbe mystus** (LINNÆUS); 5 specimens; 85–160 mm. standard length; 2 localities.
18. **Eutropius niloticus** (RÜPPELL); 7 specimens; 195–290 mm. standard length; 4 localities.
19. **Bagrus bajad** (FORSKAL); 1 specimen; 165 mm. standard length; 1 locality.
20. **Clarotes laticeps** (RÜPPELL); 8 specimens; 112–310 mm. standard length; 5 localities.
21. **Auchenoglanis occidentalis** (CUVIER AND VALENCIENNES); 1 specimen; 275 mm. standard length; 1 locality.
22. **Synodontis schall** (BLOCH AND SCHNEIDER); 5 specimens; 77–195 mm. standard length; 2 localities.
23. **Synodontis clarias** (LINNÆUS); 1 specimen; 230 mm. standard length; 1 locality.
24. **Malopterurus electricus** (GMELIN); 1 specimen; 240 mm. standard length; 1 locality.

Carp

25. **Labeo niloticus** (FORSKAL), and
26. **Labeo horie** HECKEL; 20 specimens; 105–410 mm. standard length; 6 localities. Both of these forms represented, but there is doubt to which some of the material is referable.

27. **Labeo coubie** RÜPPEL; 2 specimens; 90-110 mm. standard length; 1 locality.
28. **Barbus bynni** (FORSKAL); 2 specimens; 140 mm. standard length; 1 locality.

Miscellaneous

29. **Ophicephalus obscurus** GÜNTHER; 3 specimens; 210 mm. standard length; 1 locality.
30. **Lates niloticus** (LINNÆUS); 4 specimens; 170-290 mm. standard length; 3 localities.

Cichlids

31. **Tilapia nilotica** (LINNÆUS); 49 specimens; 55-370 mm. standard length; 8 localities.
32. **Tilapia zillii** (GERVAIS); 8 specimens; 90-120 mm. standard length; 2 localities.
33. **Tilapia galilæa** (ARTEDI); 3 specimens; 65-105 mm. standard length; 1 locality.

Various methods are followed for drawing a line between two adjacent faunal areas. That which appears to the writer most satisfactory is based on the affinity of the majority of the commoner species at localities in debatable territory. It was on this basis, and taking an Angolan collection to hand as representative, that Angola was placed with the East and South African faunal area, rather than with the West African dominated by the Congo fauna.¹ On the same grounds there can be no question that the Nile and Congo belong together.

Any fauna is a composite affair, made up of elements derived at different times and from different directions. What gives a fauna its peculiar character is the modification and, more especially, the proportions of these elements. In the Congo we have a very strong fauna comprising a multitude of species, representing groups which have little relationship and diverse history. Among them are various species of the genus *Barbus*, taken as a whole doubtless of recent Asiatic derivation. This Asiatic genus, however, forms so small a proportion of the total that its presence gives no pretext for grouping the fauna of the Congo with that of Asia. As a matter of fact the two belong in different main divisions of the continental fresh-water fish fauna of the world.

There seems to be no theoretical necessity for fishes of one taxonomic group to have entered a given area at approximately one time and from the same direction and for those of another taxonomic group to have had

¹Nichols and Boulton, 1927, Amer. Mus. Novitates, No. 264, pp. 1-2.

an unlike source or distributional history. However, bearing in mind many minor exceptions, the constitution of faunæ indicates that such has been the general rule. Thus we may consider mormyrids and characins pre-eminently West African, the genus *Barbus* Asiatic, etc. An analysis of 234 species identified by Nichols and Griscom¹ in very extensive collections of the American Museum Congo Expedition shows 36 per cent mormyrids and characins, 27 per cent catfish; 4 per cent *Barbus*; 9 per cent cichlids; and 24 per cent otherwise distributed. A similar analysis of the 33 species in the Nile collection to hand gives 42 per cent mormyrids and characins; 27 per cent catfish; 3 per cent *Barbus*; 9 per cent cichlids; and 18 per cent otherwise distributed. The correspondence in proportions is rather remarkable and distinctly is evidence of the unity of the Nile-West African fauna. The Nile fauna is a perfectly well-marked subdivision of the above, however. Comparatively few of the common Nile species are actually identical with those found in the Congo, and the presence of such identical species in the Nile is very likely due to recent penetration from the Congo. The Congo fauna is very rich, with abundant species, the Nile fauna correspondingly, almost surprisingly poor, with few species, but these abundant in individuals.

Recent study of the problem indicates certain modifications of the faunal areas postulated by Nichols and Griscom¹ (p. 741, Map 2) for African fresh-water fishes. The primary Nile-West African faunal area (with the Nile area as a subdivision) does not include Angola but appears to be limited on the south by rising land along a line running east and west, north of 10° latitude. Perhaps even the headwaters of north-flowing Congo affluents should be considered to lie outside this area in a more or less well-marked transition belt.² It may be noted that, although this line more or less corresponds with the edge of broken forest, it is doubtless more dependent on topography, as there is little difference between fishes of the Congo and those of the Nile.

It is next in order to compare the Nile and West African fauna with that of East and South Africa. To do so intelligently one should consider the fresh-water fishes of the world in general. There is one main modern group of fresh-water fishes, the Ostariophysi. Of Tertiary origin or distribution, it dominates suitable continental fresh waters of the world, with the exception of Australia. Its derivation is not clear, though probably from some more primitive, equally fresh-water, isospondyles. Various combined with more primitive fresh-water elements, and with

¹1917, Bull. Amer. Mus. Nat. Hist., XXXVII, Art. 25, pp. 653 to 756.

²Nichols, 1928, Amer. Mus. Novitates, No. 309, p. 4.

fresh-water elements which show marine affinity, it is the modern distinctive fresh-water fauna. The area dominated by it is the continental fresh-water faunal area.

The distribution of all of the three principal groups of Ostariophysi, namely, characins, catfishes, and carps, seems to have been from the north. Although it is not unlikely that their common ancestor resembled the characins most closely, the order of distribution seems to have been first catfishes, then characins, and lastly carps. At least it is certain that the carps are much more recent than the other two. They have not yet reached South America and are recent invaders in Africa. Characins, on the other hand, are now confined to tropical and South America and to Africa, where they form a very important element of the faunæ; and catfishes show a much greater abundance and diversity of form in the southern, than in the northern, continents. This is the basis for a first division of the primary continental into northern and austral faunæ. The austral fauna of Africa and South America has other characteristic elements aside from the characins and an abundance of catfishes. Such an element common to both continents is the modern acanthopterygian family of cichlids, related to the marine tropical reef pomacentrids. The history and distribution of cichlids is not easily explained. Nichols and Griscom¹ suggest that they were originally of marine origin, decended perhaps from pomacentrids or a common ancestor, and had specialized or differentiated to some extent before leaving the sea, and entering Africa and South America directly and independently from salt water. The austral divides itself naturally into an African and a Neotropical fauna on the basis of fundamental differences in the characins of the two continents, about what one would expect from complete isolation of the two groups since entering the southern hemisphere, and presence of the more primitive mormyrids, which there form an important element, in Africa.

To return to consideration of the components of the African austral fauna, it has been noted that the carps, though comparatively recent invaders from Asia, are present in Africa, in fact they are well established throughout that continent. In the Nile-West African area characterized by an abundance of mormyrids, characins and catfishes, they form only a minor element of the fauna. This is particularly true of the genus *Barbus*, a dominant present-day carp genus in southern Asia. In East and South Africa *Barbus* is a dominant element, correlated with a comparative scarcity of the typically West African groups, and thus the East and South African area, with a poorer fauna, has also a more northern, less austral

¹1917, Bull. Amer. Mus. Nat. Hist., XXXVII, Art. 25, pp. 653 to 756.

aspect than the Nile and West African area. An important cichlid element helps to classify its fauna as African austral rather than with the Asiatic northern faunæ.

Africa's two primary austral continental faunæ are then the Nile-West African, and East and South African. In delimiting the boundaries between them it will probably be best to recognize certain intermediate or transition areas belonging properly to neither. Such would include Tanganyika and probably other of the great lakes; a locality recently studied in the southeast corner of the Congo basin,¹ and probably other of the north-flowing headwaters of the Congo. Our view that the cichlids are not a truly continental element, and have come in recently from the outside accords with their inflorescence in the lakes if these be considered transition territory; study of transition areas in general having led to the conclusion that such are particularly favorable for the establishment of outside forms.

The above discussion may be understood more readily with reference to the writer's following tentative tabulation of the world's fresh-water fish faunæ. It first divides fresh-water fishes into two main faunæ, continental and peripheral. The continental is dominated by the carp-catfish-characin group. It occupies continental Eurasia, Africa, and the Americas, with the exception of a rather vague northern circumpolar area, and the southern tips of South America and Africa. The peripheral is made up of elements with better-marked affinities to salt-water groups. It occupies a vague northern circumpolar area (trouts and pikes); the southern tips of South America and Africa (*Galaxias*); Australia and the islands of the world in general. No attempt is here made at analysis down to the ultimate recognizable faunal unit, and doubtless certain lesser units which are not mentioned from the writer's comparative unfamiliarity with them may be of greater importance than others which are mentioned because they have recently been subjects of his attention. In general, however, the list aims to be comprehensive.

FRESH-WATER FISHES

I. Peripheral

1. Boreal
2. Austral
3. Insular and Australian
 - A. Australian
 - B. Insular
 - a. West Indian
 - b. Oceanic

¹Nichols, 1928, Amer. Mus. Novitates, No. 309, p. 4.

II. Continental

1. Northern

A. Holarctic

a. Palearctic

b. Neartic

B. High Asiatic

C. Indian and Oriental

a. Indian

b. Chinese

x. Temperate

y. Subtropical

2. Austral

A. African

a. East and South African

b. Nile and West African

B. Neotropical

a. Middle American

b. South American

It is somewhat remarkable, if the West African and East and South African areas were ecologically comparable to what they are today, and at the same time in contact through the Tertiary, that the West African fauna did not give rise to adaptive forms in East and South Africa, which would have been too strong to be replaced by the more recent Asiatic invasion of that territory. The West African fauna is comparable to the Neotropical, and an equally rich and strong fauna. The Neotropical fauna has adapted itself to the uplands of that continent.

The invasion of Africa from Asia, by the genus *Barbus* at least, seems to have been recent. Study of the distribution of the group in Asia would place this invasion not earlier than the Pliocene, and it must have taken place under physiographic and climatic conditions in northeast Africa unlike those of today. It can not have been via the Nile, but was in a land connection across what is now the southern end of the Red Sea. The present Arabian deserts would also have been an obstacle thereto. It is easier to suppose these to be the result of recent elevations in Asia than that so recent a land highway existed across the deep waters of the Arabian Sea, which would have accomplished the same result.

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SEVEN NEW REPTILES FROM FUKIEN PROVINCE, CHINA¹

CLIFFORD H. POPE

In this paper I describe six new snakes and a new lizard collected by myself in Fukien Province for the Third Asiatic Expedition of The American Museum of Natural History during 1925 and 1926. The American Museum's earlier reptile collections from China were reported by Karl P. Schmidt in 1927. A report on all the more recently collected Chinese reptiles, now in manuscript form, will appear shortly, bringing the matter up to date:

Kuaton, from where many species have been described, is a village in the mountains of Ch'ungan Hsien, the type locality for all but one of the new species described herein.

SAURIA

Lacertidæ

Apeltonotus sylvaticus, new species

TYPE.—A. M. N. H. No. 34975; ♀; Ch'ungan Hsien, northwest Fukien Province, China; April–September, 1926; Clifford H. Pope.

DIAGNOSIS.—This species differs from *dorsalis* in having a less distinct collar, much shorter limbs, more scales across the middle of the back, a greater number of transverse series of ventral plates, and a distinctive color pattern.

DESCRIPTION OF TYPE.—Head twice as long as broad, its length contained $4\frac{1}{2}$ times in total length to vent; snout acutely pointed, a little longer than postocular part of head, with a sharp canthus, and a vertical, slightly concave loreal region. Neck slightly narrower than head. Hind limb stretched forward fails to reach elbow; fore limb stretched backward fails to touch knee; foot slightly longer than head; tail long, slender.

Nasals not in contact behind rostral; rostral and frontonasal forming a short suture; frontonasal longer than broad; frontal as long as its distance from end of snout, narrower behind than in front; parietals about $1\frac{1}{2}$ times as long as broad, outer border convex; interparietal small, slightly longer than frontonasal; occipital very small; 2 large and 2 small supraoculars; supraciliaries 5, separated from supraoculars by a series of granules. Rostral just separated from nostril; a single postnasal; anterior loreal barely half as large as posterior, only third and fourth upper labial in contact with posterior loreal. Four pairs of chin-shields, first pair completely in contact, second barely separated posteriorly.

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 81.

Scales on back largest, strongly keeled, those on sides granular, the two types gradually merging, slightly intermixed, 44 scales across middle of body. Ventral plates in 6 longitudinal, 24 transverse rows, plates of outer longitudinal row distinctly keeled and pointed, remainder barely so. Preanal plate large, smooth, bordered by a semicircle of 6 plates as large as those of last transverse row of ventrals; 4 of 6 are anterior, 2 lateral. Three femoral pores on each side; 26 lamellæ under fourth toe. Caudal scales strongly keeled, twice as long as largest dorsals.

Color, dark green above, lighter below, lightest on the throat. A continuous white stripe from subocular to base of hind leg. This line passes just below tympanum, above base of fore limb, and along fourth to sixth lateral rows of scales; vivid on head and neck, distinctly less so on body.

Four paratypes, all from type locality, Nos. 34972-974 and 34976.

SERPENTES

Colubridæ

Pseudoxenodon fukienensis, new species

TYPE.—A. M. N. H. No. 34650; ♂; Ch'ungan Hsien, northwest Fukien Province, China; April-September, 1926; Clifford H. Pope.

DIAGNOSIS.—A small *Pseudoxenodon* without a caudal stripe but with a vivid head and body pattern persistent throughout life. The ventral count is low, the caudal high, and, as might be expected, the tail proportionately long. Lower labials only 8-8.

DESCRIPTION OF TYPE.—Rostral broader than deep, just visible from above; internasals shorter than prefrontals; frontal much longer than broad, as long as its distance from end of snout, slightly shorter than parietals, which are as long as their distance from internasals. Loreal deeper than long; preoculars 1-1; postoculars 3-3; both anterior and posterior temporals 2-2; upper labials 8-8, fourth and fifth entering eye. Four pairs of lower labials in contact with anterior chin-shields. Scale formula 19-17-15, the reduction from 19 to 15 taking place so abruptly at midbody that the section covered by 17 rows is equal only to width of some 20 ventral plates; at midbody all scale rows keeled. Ventrals 138; anal divided; subcaudals 62; total length 616 mm., 0.22 occupied by tail.

Fundamentally, the dorsal color pattern is strikingly like that of the other *Pseudoxenodons*, but actually it is distinct because of the different values of the component parts. The rather faint, middorsal light spots, 36 in number, are black-bordered before and behind, and from side to side cover 3 or 4 scale widths, while longitudinally they cover the length of a scale. The lateral black spots fall opposite the central light ones and are about twice as large. There is a purplish tinge to the ground color along the sides that is lacking down the middle of the back. On the tail only the light spots, 15 in number, predominate, for there the rest of the pattern is obscure.

The ventrum has the usual dark speckling which is almost lacking on the first score of ventral plates just as in the other *Pseudoxenodons* described herein. The speckling is proportionately less concentrated laterally, but the individual spots tend to run together along the base of each plate, and, posteriorly, across the center. The greatest profusion of speckles is reached before the anus, for behind it they are only moderately profuse and almost lacking along the juncture of the divided subcaudal plates.

The top of the head is black except for a gray interocular band and a gray temporal stripe irregular in outline extending from the eye to a little above the angle of the mouth. The side of the head between the eye and nasal opening is also gray, as is the rostral plate. At the sutures between each of the first 5 upper labials is a wedge-shaped, black spot directed downward. A postocular stripe, just below the temporal one described above, borders the sixth and crosses the last 2 upper labials, sending a point downward at the suture between the sixth and seventh. There is a very conspicuous V-shaped, black band across the neck whose apex reaches almost to the parietals.

All of the 14 paratypes are from the type locality. Their numbers are 33749, 34642-649 and 34651-655.

***Pseudoxenodon karlschmidtii*,¹ new species**

TYPE.—A. M. N. H. No. 34658; ♀; Ch'ung-an Hsien, northwest Fukien Province, China; April-September, 1926; Clifford H. Pope.

DIAGNOSIS.—A *Pseudoxenodon* allied to *sinensis* from which it differs through a lack of yellow in the dorsal pattern, in having a narrower head, higher labial count, more ventrals in the males, fewer in the females, and fewer subcaudals in both sexes. Moreover, *karlschmidtii* undergoes a more marked color change during ontogeny.

DESCRIPTION OF TYPE.—Rostral broader than deep, just visible from above; internasals much shorter than prefrontals; frontal much longer than broad, barely as long as its distance from end of snout, just as long as parietals, which are much less than twice as broad in front as behind. Loreal deeper than long; preoculars 1-1; postoculars 3-3; anterior temporals 2-2; posterior, 2-3. Upper labials 8-8, fourth and fifth entering orbit; lower labials 9-10; four in contact with anterior chin-shields on one side, 5 on other. Scales reduced from maximum of 19 to minimum of 15 at mid-body, consequently, count of 17 extends along a distance equal to width of only some 6 ventrals. Ventrals 154; anal divided; subcaudals 56; total length 796 mm., 0.18 taken up by tail.

The ground color of the dorsum is blackish gray. Down the middle of the back are 24 light gray spots. From side to side each spot covers the width of 4 to 6 scales, but longitudinally only the length of one. Some of these spots lie obliquely and all are surrounded by scales part black and part gray. Anteriorly on either side is a very indistinct row of darkish spots made up of black-bordered scales. These darkish spots for the most part alternate with the middorsal spots. The majority of the dorsal scales have minute traces of black. The light, middorsal row of spots extends on to the tail where there are 5 distinct and 2 indistinct ones. There the black borders are very indistinct. Beginning about 20 plates from the chin-shields, the ventrals are speckled with black more and more profusely toward the tail under which the speckling is so profuse that the subcaudals appear black. Laterally the speckles are concentrated along the tips of the ventrals to form a line, while in general they are gathered along the bases of the scales. The tips of even the first 20 plates are black.

¹Named for Mr. Karl P. Schmidt who has already reported the former Asiatic collections of the American Museum.

The ventral surface of the head is immaculate. The temporal region is darker than the dorsal surface of the head but there is no distinct postocular band. All but the last 2 upper labials on either side are narrowly bordered with black behind.

There are 6 paratypes (A. M. N. H. Nos. 34638-641 and 34659-660).

***Pseudoxenodon striaticaudatus*, new species**

TYPE.—A. M. N. H. No. 33759; ♀; Ch'ungan Hsien, northwest Fukien Province, China; June-July, 1925; Clifford H. Pope.

DIAGNOSIS.—A *Pseudoxenodon* differing from its ally, *dorsalis*, in having a higher ventral and subcaudal count, and in lacking all traces of yellow or red in its coloration.

DESCRIPTION OF TYPE.—Rostral much broader than deep, just visible from above; internasals slightly shorter than prefrontals; frontal longer than broad, as long as its distance from the rostral, shorter than the parietals which are twice as broad in front as behind. Loreal deeper than long; preoculars 1-1; postoculars 3-3; both anterior and posterior temporals 2-2. Upper labials 8-8, fourth and fifth entering eye; lower labials 9-10, four in contact with anterior chin-shields on one side, 5 on the other. Nineteen rows of scales on neck, 17 from neck to midbody, 15 from middle of body to anus; at midbody all but 3 rows on either side feebly keeled. Ventrals 148; anal divided; subcaudals 55. Total length 776 mm., tail 0.18 of total.

The dorsum is an obscure, intricate mixture of black and gray, blending on the neck to give a uniformly dark appearance but arranged along the midregion to form indistinct, black-bordered, diamond-shaped spots reaching to the second scale row on either side. Most of the scales not entering this pattern are gray, many others are gray but bordered with black, while a few are entirely black. From a point a tail's length anterior to the anus a black-bordered, middorsal, light gray stripe extends to tip of tail. This is the most conspicuous marking on the dorsum. The light ventrum is profusely spotted with black. The spots run together laterally to form a black band and centrally are most numerous along the anterior edge of each plate. The spots are varied in size and shape and hazy in outline. They are present only on the tips of the first few ventrals.

There is a dark line from behind the eye to the angle of the mouth while all but the last 2 upper labials are black-bordered posteriorly. The ventral surface of the head is milky white.

There are 20 paratypes, all from the type locality (Nos. 33760-762, 34596 and 34662-677).

***Dinodon futsingensis*, new species**

TYPE.—A. M. N. H. No. 34106; juvenile ♀; Futsing Hsien, Fukien Province, China; August-October, 1925; Clifford H. Pope.

DIAGNOSIS.—A black and white banded *Dinodon* allied to *ruhstrati*. The scales are smooth, in 17 rows on the neck and at midbody, 15 just before the anus. Ventrals 197; subcaudals 79. Also allied to *yunnanensis* and *septentrionalis*.

DESCRIPTION OF TYPE.—On the anterior extremity of the maxillary there are 4 small, subequal teeth. These are followed immediately by 4 much larger ones, the third of which is the longest. The remaining teeth, about 3 in number, are arranged along the maxillary some distance behind the first 8.

Rostral broader than deep, plainly visible from above; internasals distinctly narrower than the prefrontals and only half as long. Frontal slightly longer than broad, shorter than parietals, as long as its distance from end of snout. Loreal twice as long as deep, not entering eye; preoculars 1-1; postoculars 2-2; anterior temporals 2-2; posterior, 3-3. Upper labials 8-8, the third, fourth and fifth entering the orbit on one side, the fourth, fifth and sixth, on the other; lower labials 10-10, the first 5 in contact with the anterior chin-shields which are a little shorter than the posterior. Anal entire. Total length 227 mm., 0.21 occupied by tail.

The body is black, crossed by 22 white bands which are 2 scale lengths in width on the middle of the back but wider on the sides where they join the faintly clouded, white belly. Nearly all of these bands split just before they reach the ventrals. The 12 white bands on the tail scarcely widen laterally. Except on the neck, where they are much more widely separated, these white bands are 5 to 6 scale-lengths apart. The subcaudals are dark. There is a conspicuous white area extending anteriorly as far as the eyes and posteriorly 3 scale-lengths behind the parietals. Laterally it extends to the next to the last upper labial and finally joins the white of the throat. There are slight traces of black on this area, the most conspicuous being a narrow line from the posterior tip of the parietals to the beginning of the black ground color of the neck.

The single paratype, No. 34105, is also from Futsing Hsien and agrees remarkably well with the type.

***Opisthotropis kuatunensis*, new species**

TYPE.—A. M. N. H. No. 34437; ♀; Ch'ungan Hsien, northwest. Fukien Province, China; April-September, 1926; Clifford H. Pope.

DIAGNOSIS.—An *Opisthotropis* allied through strongly keeled scales and a high upper labial count to *rugosa* and *typica* of Sumatra and Borneo. The nasals are undivided and the prefrontal single.

DESCRIPTION OF TYPE.—Maxillary teeth 25, small, subequal. Head broad, depressed; nostrils near upper edge of the nasals which are not in contact. Internasals long, curved outward; prefrontal single. Frontal large, a little longer than broad, much shorter than parietals. Supraocular divided on one side, entire on other; loreal longer than deep. Preoculars 2-2; postoculars 2-3. A total of 6 scales enter orbit on 1 side, 9 on other. Anterior temporals 1-1. Only first 6 upper labials on one side, first 8 on other, extend from head shields to labial border; those following are divided horizontally, first into double, then triple, then again double, rows. Their number, when only those entering margin are counted, may be given as 15-16; lower labials even more irregular. The very finely rugose anterior chin-shields are several times the size of the narrow posterior ones. Scales in 19 rows, striated and strongly keeled throughout. Ventrals 160; anal divided; subcaudals 63. The tail occupies 0.23 of total length which is 666 mm.

The uniform olive-brown of the back extends down on either side to the third row of scales and is marked only by 3 very obscure, black, longitudinal lines, each as wide as a scale. The belly and first 3 rows of scales on either side are uniformly light. The ventral surface of the tail is clouded except just behind the anus.

The 15 paratypes (Nos. 33708-710, 34428-436, and 34438-40) come from the type locality.

***Hemibungarus kelloggi*,¹ new species**

TYPE.—A. M. N. H. No. 33744; ♀; Ch'ungan Hsien, northwest Fukien Province, China; June-July, 1925; Clifford H. Pope.

DIAGNOSIS.—A *Hemibungarus* with 15 rows of scales, no longitudinal lines on the body, and head rather distinct from the neck.

DESCRIPTION OF TYPE.—Maxillary with a pair of large, grooved poison-fangs and 2 small, solid teeth separated by a space from the fangs. Rostral broader than deep; frontal a little longer than deep, as long as its distance from tip of snout, and much shorter than parietals. Diameter of eye equal to its distance from edge of lip; pupil round. Upper labials 7-7, third and fourth entering eye, sixth largest. Lower labials 6-6, four pairs in contact with anterior chin-shields. Preoculars 1-1; postoculars 2-2; anterior temporals 1-2; posterior temporals 2-2. Scales in 15 rows throughout. Ventrals 203; subcaudals 28, divided. Anal divided. Total length 774 mm., 0.09 of which is occupied by tail.

The dorsum is purplish brown with 3 sets of markings. The most conspicuous of these is made up of 22 light-edged, black cross-bands, each a scale length in width, distributed down the back and descending to the edge of the ventrals. They may even join the ventral spots. This set is continued on the tail where there are 3 additional bands. The second set of markings is composed of a series of paired, light-edged black spots, each about the size of a scale, located on either side of the central scale row midway between the cross-bands. On the tail these spots are a little irregular. The third set of markings is a broken series of small, black spots each occupying the center of a mid-dorsal scale. These spots are absent on the neck, tail, and the scales adjacent to the cross-bands.

The ventrum is milky white with 49 black blotches of varying size and outline disposed along its center. Five of the blotches fall behind the anus.

The head is black, crossed by 2 white bands; a narrow one beginning on the second and third upper labials and crossing over the snout at the juncture of the pre-frontals with the internasals; a much broader one with the form of a shallow V having its anterior edges on the posterior upper labials and its apex at the posterior tip of the frontal.

There are 3 paratypes, all from Ch'ungan Hsien, A. M. N. H. Nos. 33490, 34104, and 34588.

¹Named after Mr. Claude R. Kellogg, of the Fukien Christian University, who is devoting his life to the teaching of zoology in China.

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BEES OF THE GENUS *PERDITA* SMITH IN THE AMERICAN
MUSEUM OF NATURAL HISTORY (HYMENOPTERA)BY P. H. TIMBERLAKE¹

The genus *Perdita* Smith is one of the most characteristic genera of North American bees and is peculiar to the North American continent. Its center of distribution is the arid regions of the Southwestern States and Northern Mexico, but it has a representative on the Atlantic Coast as far north as New Brunswick and as far south as Guatemala. On the Pacific Coast the genus is well represented in Lower California and spreads northward as far as Victoria, British Columbia.

The following records of species in The American Museum of Natural History are new and will add considerably to the known range of many of the species. Three of the species are here described as new, and three others are new species which are being published elsewhere. I have arranged the species in groups designated by the earliest described component species.

***Perdita georgica* Timberlake**

2 ♀, De Funiak Springs, Florida, October 17 and 19, 1914 (F. E. Watson and A. J. Mutchler).

The description of this species will appear elsewhere, and the above specimens will be recorded in it as paratypes. This species belongs to the *ignota* group.

***Perdita callicerata* Cockerell**

3 ♀, 5 ♂, Coyote Mts., Arizona, at an altitude of about 3500 feet, August 4 to 7, 1916 (Frank E. Lutz); 1 ♀, north side of Kits Peak, Baboquivari Mts., Pima County, Arizona,* at an altitude of about 3600 feet, August 7 to 9, 1916 (Frank E. Lutz).

Callicerata is a member of the *ignota* group. The specimens collected in the Coyote Mts. were taken on *Baileya multiradiata*.

¹Citrus Experiment Station, Riverside, California.

***Perdita albobittata* Cockerell**

1 ♀, Black Dike Prospect, Sierritas, Arizona, July 26 to 29, 1916 (Frank E. Lutz).

This species seems in every way characteristic of the *ignota* group, except that the maxillary palpi are 5-jointed. It is the type of the subgenus *Pentaperdita* Cockerell and Porter.

***Perdita albipennis* Cresson**

1 ♀, 3 ♂, La Junta, Colorado, at an altitude of 4100 feet, August 12, 1920 (Dr. and Mrs. Frank E. Lutz); 1 ♀, Denver, Colorado, September 5, 1920 (L. O. Jackson); 1 ♂, Brownsville region, Texas, January 2-13, 1928 (F. H. Benjamin).

The Brownsville specimen agrees with the var. *helianthi* Cockerell in the color of the antennæ, but the abdomen is entirely dark. *P. albipennis* is the type of the subgenus *Cockerellia* Ashmead, which is very closely allied to the *ignota* group both in somatic and in genitalic characters.

***Perdita lacteipennis* Swenk and Cockerell**

1 ♀, La Junta, Colorado, at an altitude of 4100 feet, August 12, 1920 (Frank E. Lutz).

***Perdita bequaerti* Viereck**

1 ♀, Mobile, Alabama (T. S. Van Aller); 6 ♀, 2 ♂, South McAlester, Indian Territory (now Oklahoma), June 11 (Wickham).

This species, like the preceding, belongs to the *albipennis* group. I have seen specimens of *P. bequaerti* also from Knoxville, Tennessee (G. G. Ainslie) and Bryson City, North Carolina (Crawford). The Oklahoma specimens evidently form a part of a series, from which the type of *P. wickhami* Cockerell was selected and submitted to Dr. Cockerell for determination. These specimens might possibly be regarded as a western race, with slightly smaller face marks than in typical *bequaerti*, but there is no question that *wickhami* and *bequaerti* are conspecific.

***Perdita octomaculata* (Say)**

1 ♂, Mosholu, New York, August 30, 1919 (Frank E. Watson); 5 ♀, Keene Valley, Essex County, New York, August 7 to 16, 1917 (H. Notman); 7 ♀, 4 ♂, Lake George, New York, August 22, 1894 and August 3, 1903 (Zabriskie); 1 ♀, 1 ♂, Franconia, New Hampshire

(Mrs. Slosson); 1♂, Putnam, Connecticut, August 5, 1919, on *Solidago* (A. Barrett Klots); and 1♀, Florence, South Carolina, October 12, 1916 (A. H. Sturtevant).

P. octomaculata is typical of a rather large group of species, restricted mainly to the region east of the Rocky Mountains.

***Perdita consobrina*, new species**

1 ♀ (holotype), Sumter, South Carolina, October 13, 1916 (A. H. Sturtevant).

The female runs to *P. affinis* Cresson, var. (couplet 80) in Cockerell's table (Proc. Acad. Nat. Sci., Philadelphia, 1896) but, as the supraclypeal mark is in the form of two small spots and perhaps sometimes absent in a series, it might also run to typical *affinis* in couplet 62. It differs from *affinis* in having the head longer than wide, the facial quadrangle narrower, the clypeus much more projecting in front of ocular line, the mesonotum as dull as the frons, the pale markings bright yellow instead of yellowish white, etc. It is a member of the *octomaculata* group and differs from *P. octomaculata* (Say) in its smaller size, narrower head, duller and hairy mesonotum, the marks on abdomen much larger and not so widely separated, etc. From *P. jonesi* Cockerell it differs in having the stigma pallid centrally, the tegulæ hyaline instead of light reddish brown, the abdominal marks much larger (larger than in *octomaculata* instead of smaller), the lateral face marks larger and not pointed above, etc.

FEMALE.—General form ordinary. Head a little longer than wide, the facial quadrangle very distinctly longer than wide. Cheeks ordinary. Eyes considerably more than twice as long as wide, the inner orbits slightly and broadly emarginate opposite the middle of frons. Clypeus rather prominent and strongly projecting in front of ocular line; disk convex, somewhat broader than long and broadly truncate above between dog-ear plates; lateral extensions of clypeus strongly reflexed, extending obliquely backward from sides of labrum toward base of mandibles, rather wide at inner ends and not at all visible in frontal view of head. Dog-ear plates very large and pointed below. Lateral plates of face strongly widened at lower ends and each at a point opposite middle of dog-ear plates, covering about one-fifth the total width of face. Prominence between antennæ high and tectiform, the carina of the ridge extending on to frons and continued above as a smooth fine line to anterior ocellus. Mandibles curved, rather slender, acute at apex and reaching to far margin of labrum. Antennæ ordinary, the joints of flagellum about as long as thick. Abdomen oval, about twice as long as wide, convex above, the pygidium broad at base and narrow and obtuse at apex. Membrane of wings densely covered all over with fine short setæ; stigma narrowly lanceolate, somewhat shorter than first submarginal cell, and emitting the radius slightly beyond the middle; marginal cell as long as stigma obliquely truncate at apex, and with the substigmal and poststigmal parts about equal; second submarginal cell narrowed about two-thirds to the marginal cell;

third discoidal cell distinct, the recurrent veins interstitial with the intercubiti. Claws missing in type, but probably with a fine subapical inner tooth as in other species of the *octomaculata* group.

Frons, vertex, mesonotum and metanotum dull and granular tessellate, and having the numerous setiferous punctures extremely fine and indistinct. Dog-ear plates and lateral plates, except below, sculptured much like the frons, but lower end of lateral plates, supraclypeal area, and clypeus polished, or with a fine indistinct tessellation only on the more dorsal parts, the clypeus also having sparse shallow punctures. Cheeks strongly tessellate, somewhat shining, without a smooth strip next to eyes and with numerous fine rather indistinct punctures. Propodeum, pleura, and sternum distinctly tessellate and rather more shining than cheeks, the posterior face of propodeum smoother and strongly shiny, the mesopleura punctured like the cheeks. Pubescence of head and thorax beneath whitish and tinted with ochreous above, the hairs briefly plumose and appearing rather coarse; on cheeks, pleura, and apex of abdomen rather long and moderately dense; rather dense but short and erect on mesonotum; longer on frons, especially around bases of antennæ, and on the vertex posteriorly, but short on middle of frons. Face below antennæ almost nude. Scopa of hind tibiæ rather thin and long, the hairs on the anterior side of tibiæ strongly curved and simple.

Head and thorax very dark green, the propodeum and pleura very slightly bluish green. Mandibles except reddish apices, labrum, clypeus, lateral face marks, and two small supraclypeal spots bright yellow. Remainder of supraclypeal plate piceous, but dog-ear plates dark green. Disk of clypeus with two piceous vittæ, convergent and pointed above, somewhat thickened and bifid below, where they end slightly below the middle of disk. Anterior margin of disk of clypeus, very narrowly, and a transverse band at base of labrum, extending on to inner margin of lateral extensions of clypeus, brown. Lateral face marks much higher than broad, broad below and with the inner corners rounded next to clypeus, narrowing about one-half just above level of top of clypeus and extending with the same width to frontal foveæ, where they are obliquely truncate and reach half-way from orbital margin to antennal sockets. Cheeks entirely dark. Small spot on posterior corners of pronotum and the tubercles yellow. Abdomen piceous above and below, with a slight greenish luster on the first tergite, the pygidium reddish. Tergites 1-5 each with a yellow band, reaching to lateral margins except on 5, and more or less distinctly interrupted medially. Band on tergite 1 subapical, narrow, straight, narrowly interrupted medially, and abruptly and quadrately enlarged at lateral margins. Band on 2 in form of two widely separated triangular spots, one at each basal corner, pointed within on basal margin, reaching along lateral margins to the apical depression, extending broadly on to the reflexed part of the tergite and enclosing the black lateral foveal line. Band on 3 much less broadly interrupted medially than on 2 but much more than on 1, oblique at sides where it extends on to the reflexed part of tergite and tapering medially to rather sharp points on basal margin. Band on 4 similar to that on 3, but reaching only to lateral margins, nearly uniform in width, linearly interrupted at middle, arcuate and about one-fourth as wide as length of segment. Band on 5 very similar to that on 4, except that it is rather less arcuate and does not quite reach to lateral margins. Maxillæ piceous, the labium brown. Antennæ piceous, the scape rather broadly yellow beneath, the flagellum narrowly dull yellow beneath. Legs piceous, all the knees, front tibiæ broadly on anterior side and middle tibiæ narrowly in front, yellow;

front tarsi yellowish anteriorly but otherwise brown. Tegulae hyaline with a yellow spot at base, but appearing almost entirely yellowish because of the underlying yellow wing bases. Wings hyaline, slightly tinted with fuscous, but appearing rather whitish at certain angles; veins and margins of stigma brown, the stigma with a distinct central pallid streak.

Length about 5.5 mm.

***Perdita gerardiæ* Crawford**

2 ♀, 3 ♂, Gainesville, Florida, September 26 to October 2, 1914 (A. J. Mutchler and F. E. Watson).

P. gerardiæ belongs to the *octomaculata* group. At the time of writing, *gerardiæ* is still a manuscript species, which I have identified through specimens contributed by Mr. Crawford.

***Perdita affinis* Cresson**

2 ♀, 3 ♂, Jim Creek, near Boulder, Colorado, altitude about 7000 feet, August 3, 1922 (Frank E. Lutz).

P. affinis seems to be rather variable, and these specimens belong to the large variety. *Affinis* is also a member of the *octomaculata* group. One of the females was collected on *Grindelia*.

***Perdita wheeleri*, new species**

1 ♂ (holotype) collected in May, 1905, in Indian Gardens in the Grand Cañon, Arizona (W. M. Wheeler).

It is a pleasure to name this very interesting and distinct species for its discoverer, Dr. William Morton Wheeler.

The male runs to *P. nitidella* Cockerell (couplet 71) in Cockerell's table, but it is not at all closely allied and is also distinct from other species falling at the same place (*P. wilmattæ*, *tropicalis*, *mentzeliarum* and *mentzeliarum* var. *laeta*, all of Cockerell). In some respects, especially in the color of abdomen, it resembles *P. tropicalis* Cockerell, but the abdomen is much shorter and broader, with the dark bands much paler, and the claws are much different. The peculiar face marks will also separate *wheeleri* from any of the above species. In structural characters, including genitalia, *wheeleri* belongs to the group of *P. mentzelix* (other verified members of the group are *P. mentzeliarum* Cockerell and *P. wootonæ* Cockerell), but differs greatly from the other species in color and markings. Like other members of the group, doubtlessly *wheeleri* will be found to vary greatly in size of the head and in the presence or absence of the genal tubercles, and it would not be surprising to learn that it visits *Mentzelia* like the other members of the group.

MALE.—Form rather robust. Head moderately enlarged, quadrate, much broader than thorax but only slightly wider than long, and distinctly wider below than above. Temples and cheeks very broad, the latter simple and well rounded next to occipital cavity. Eyes slightly more than twice as wide as long, the inner orbits very slightly and broadly emarginate above and a little divergent below. Mandibles long, slender, tapering, very acute and simple at apex, and reaching much beyond far margin of labrum. Clypeus broad, low and rather strongly depressed; the disk nearly twice as broad as high, the sides nearly straight and oblique, and the base moderately broadly subtruncate; lateral extensions rather shorter than width of disk, moderately wide at inner ends, not very strongly narrowed toward base of mandibles and inflexed on the anterior margin so that about one-half of their surface is visible in frontal view of head. Dog-ear plates not quite twice as high as wide and pointed below. Lateral plates of face only slightly widened below and each covering a little less than one-third the total width of face. Prominence between antennæ broad, low, tectiform, and rather carinate below. Frons with an impressed median line broadening toward anterior ocellus and not quite reaching below to the prominence. Posterior corners of pronotum well rounded and prominent, the disk slightly concave between them. Propleura deeply and broadly sulcate with the bottom of the sulcation rounded. Abdomen very broadly ovate, considerably less than twice as long as wide, convex and with the apex strongly recurved; apical tergite large, broad across the base and tapering to the rather narrow obtuse apex. Membrane of wings with very minute subobsolete setæ; stigma large but of ordinary width, as long as first submarginal cell and emitting the radius somewhat beyond the middle; marginal cell somewhat shorter than stigma, with the apical truncation a little oblique and appendiculate, and with the substigmal part about one-fourth longer than the poststigmal part; second submarginal cell narrowed nearly one-half above; first recurrent vein received by the first submarginal cell close to apex and the second recurrent received by the second submarginal a short distance before the apex; subdiscoidal and second recurrent veins obsolete. Claws large, abruptly bent at middle, deeply cleft and with the inner tooth a little shorter than the outer tooth.

Vertex dull, strongly tessellate and almost granular medially; frons rather shining but distinctly and finely tessellate; face below antennæ still more shining and delicately tessellate, with the tessellation more distinct on lateral plates; cheeks about as distinctly tessellate as frons. Face, sides of frons and of vertex, and the cheeks rather indistinctly and very sparsely punctured, with the punctures very fine except on the face. Middle of frons with much more distinct and closer but well separated punctures. Thorax shining, uniformly, finely, and rather delicately tessellate, the mesonotum and pleura with very fine and sparse punctures. Abdomen shining and with the usual microscopic sculpture. Pubescence remarkable for its sparsity, the entire body being practically nude, although there are a few moderately long whitish hairs on the occipital rim above. The usual hair on cheeks, pleura, and sides of propodeum is extremely sparse, fine, and short. Legs, especially middle and hind tibiae and tarsi, moderately hairy.

Head and thorax very dark green with a weak brassy luster, but the disk of mesoscutum, the scutellum, and metanotum almost black. Mandibles at base, anterior half of clypeus, and very large lateral face marks deep yellow or almost orange. Mandibles reddish at middle and rather dark red at apex. Labrum shining brown. Upper half of clypeus, dog-ear plates, and supraclypeal area piceous. Lateral

face marks covering remainder of face below antennæ, quadrate, slightly broader below, and squarely and broadly truncate at level of lower margin of antennal sockets. Cheeks with a small brownish yellow nubilous spot anteriorly but dark next to the orbits. Thorax entirely dark. Legs piceous, the front knees very narrowly, front tibiæ except behind, front tarsi beneath except on apical joint, middle knees beneath and middle tibiæ beneath, yellow; tarsi otherwise brown. Abdomen yellow but first tergite entirely and broad apical margin of tergites 2-7 brown, the dark color becoming paler and fainter on successive segments toward apex; on tergites 2 and 3 the yellow and brown bands are rather distinct and about equally wide, the yellow not quite reaching to the lateral margins, especially on 2; on the following segments the two colors shade into each other gradually. Venter entirely slightly brownish dull yellow. Labio-maxillary structure brown. Antennæ rather dark brown above, the scape narrowly and the flagellum broadly dull yellow beneath. Tegulæ glassy hyaline and testaceous at base. Wings clear hyaline, the veins rather pale brown with subcosta and margins of stigma darker, the stigma otherwise whitish.

Length about 4.0 mm.

***Perdita maura* Cockerell**

1 ♀, 3 ♂, White Rocks, near Boulder, Colorado, at an altitude of about 5500 feet, June 30, 1922 (Frank E. Lutz).

Maura seems to be an isolated species, related in a general way to the *octomaculata* and *mentzelix* groups. It is the type of the subgenus *Zaperdita* Robertson. All of the specimens were collected on *Physalis*.

***Perdita obscurata* Cresson**

1 ♀, Kushla, Alabama (A. H. Sturtevant).

Obscurata belongs to a small group of species characterized especially by the usual presence of a small intercalated submarginal cell. The group is apparently confined to the Atlantic Seaboard States and includes *P. novæ-angliæ* Viereck, *P. bradleyi* Viereck, and *P. floridensis*, new species. *P. novæ-angliæ* Viereck is the type of the subgenus *Alloperdita* Viereck.

***Perdita novæ-angliæ* Viereck**

1 ♂, Lakehurst, New Jersey, June 9 (Harry B. Weiss).

***Perdita floridensis*, new species**

2 ♀, 2 ♂ (holotype ♂, allotype and paratypes), Clearwater, Florida, May 1, 1908 (E. P. Van Duzee).

The female runs exactly to *P. obscurata* Cresson (couplet 62) in Cockerell's table (1896), and differs from that species in having the head distinctly longer than wide (wider than long in *obscurata*), the hind tibiæ dark, and the abdomen with a straight, narrow yellow band at base of

tergites 2-5, narrowly¹ interrupted or notched medially. In *obscurata* the abdominal bands are broadly interrupted medially and absent on 5.

The male runs to the male of *P. tarda* Cockerell (couplet 86) and differs therefrom in having the head a little longer than wide, the supra-clypeal mark transverse, not or hardly reaching above middle of dog-ear marks, the wings clear, with pale veins and with an intercalated submarginal cell, the abdominal marks yellow instead of white and confined to tergites 2 and 3, etc. It differs from the male of *obscurata* in not having the face entirely yellow beneath antennæ.

MALE.—Form rather elongate and slender. Head small, narrower than thorax, thin fronto-occipitally, somewhat longer than wide, gently rounded at sides and subtransverse above. Cheeks narrow and simple. Eyes large, about two and one-half times longer than wide, with the inner orbits arcuate, a little divergent below the middle, and very broadly and slightly emarginate above. Mandibles moderately stout, acute at apex, with a small inner tooth, curved, and reaching somewhat beyond far margin of labrum. Clypeus convex, somewhat prominent and rather strongly projecting in front of ocular line; disk a little broader than high and squarely truncate above between dog-ear plates; lateral extensions not very long, broad at inner ends and broadly reflexed on anterior margin, so that only a small part is visible in frontal view of head. Dog-ear plates elongate oval, somewhat pointed below and about twice as high as wide. Lateral plates of face somewhat widened at lower end and each covering at level of middle of dog-ear plates about one-fourth the total width of face. Antennæ long, joints of flagellum distinctly longer than wide but the scape hardly more than twice as long as wide. Prominence between antennæ rather high, subectiform and declivous above middle of antennal sockets, and abruptly terminated at dorsal level of the sockets. Frons depressed, without a median impressed or smooth line but with a broad very shallow median depression most noticeable above and marked above on each side by a slight rounded prominence just below the anterior ocellus. Abdomen elongate oval, considerably more than twice as long as wide, gently convex above, and with the apex moderately reflexed toward venter. Seventh tergite broad at base, tapering to the rather narrow rounded apex and depressed on disk. Membrane of wings with very fine, not dense, and subobsolete setæ; stigma, rather large and moderately broad, about as long as first submarginal cell and emitting radius slightly beyond the middle; marginal cell rather broad, as long as stigma, somewhat obliquely truncate and appendiculate at apex, and with the substigmatal and poststigmatal parts about equal; normal second submarginal cell narrowed about one-half above, but having the first intercubitus split below to include a small triangular intercubital cell¹; first recurrent vein interstitial or nearly so with outer branch of first intercubitus; subdiscoidal and second recurrent veins obsolete, the latter interstitial with second intercubitus. Claws rather large, abruptly bent at middle, not very deeply cleft at apex, and with the inner tooth stout and distinctly shorter than the outer tooth.

¹I believe with Robertson that the first intercubitus of *Perdita*, and of other Panurgidæ with two submarginal cells, is of dual origin, and that the condition in *Alloperdita* is a reversion to a remote ancestral condition. It is hardly possible to suppose that the intercubital cell has been persistent throughout the ancestry of *Alloperdita* on account of the close affinity of the group to other species of *Perdita*.

Frons and vertex finely but rather distinctly tessellate and moderately dull, the frons with rather sparse and very fine punctures. Face below antennæ polished and impunctate. Cheeks shining, finely tessellate except in a smooth strip along posterior orbits, the fine punctures numerous but well separated. Mesonotum polished and shining, but showing a fine delicate tessellation around margins of scutum and on scutellum, and with numerous, well separated, very fine punctures. Metanotum dull and very finely and densely tessellate. Propodeum and pleura tessellate and shining much like the frons, the pleura with numerous very fine punctures. Abdomen shining and with a delicate microscopic tessellation. Pubescence fine, moderately long and whitish, rather thinner than usual on cheeks, occiput, and pleura, thin and moderately short on frons, and moderately thin and long, but uniformly distributed, on mesonotum.

Head and thorax dark greenish blue. Mandibles except reddish tips, labrum, clypeus except usual pair of dots, and lateral, supraclypeal, and dog-ear marks rather bright yellow. Lateral face marks broad below, but tapering above to a narrow obtuse point at level of antennal sockets. Supraclypeal mark transverse and narrow, the greater part of the supraclypeal plate being dark. Dog-ear marks large and oval but margined nearly or quite all around with black, the acute lower point of the plates, especially, being dark. Cheeks entirely dark. Small cuneiform marks on posterior margin of pronotum and sometimes small spot at apex of tubercles yellow. Legs brownish piceous, the front and middle knees, front tibiæ except a brown streak behind, middle tibiæ in front, and all the tarsi yellow; the middle tibiæ otherwise brown. Abdomen brownish piceous above and beneath, with the last tergite yellowish brown; and tergites 2 and 3 each with a narrow basal yellow band, rather broadly interrupted in middle and as broadly separated from lateral margins. Labio-maxillary structure brown. Scape yellow, with a brownish piceous spot above at apex; flagellum dull brownish piceous above and dull brownish yellow beneath. Tegulæ nearly clear hyaline with a yellow spot at base. Wings rather distinctly milky hyaline, the stigma whitish, the veins mostly colorless, but subcosta and margins of stigma moderately dark brown.

Length about 6.0 mm.

FEMALE.—Similar to the male. Head distinctly longer than wide, very thin fronto-occipitally, slightly rounded on the sides, and nearly transverse above. Cheeks and temples narrow. Eyes about thrice as long as wide, the inner orbits parallel and nearly straight except at upper ends, where they slightly converge for a short distance. Mandibles very similar to those of male but somewhat stouter. Clypeus convex, projecting strongly in front of ocular line, but not especially prominent; disk distinctly wider than long and rather well rounded above; lateral extensions not visible in frontal view of head, very wide at inner ends and rapidly tapering toward base of mandibles. Dog-ear plates very large. Lateral plates of face a little widened below and opposite middle of dog-ear plates, each covering somewhat less than one-fourth the total width of face. Prominence between antennæ moderately high and tectiform above, the ridge reaching for a short distance on the frons. Frons not quite so much depressed as in the male and with a median, fine, impressed line extending from anterior ocellus to the prominence. Abdomen oval, rather more than twice as long as wide, the pygidium rather acutely angled at apex. Wings as in the male, except that the intercalary submarginal cell is larger, but reaching only about half-way to marginal cell, and the third discoidal cell is complete. Claws with a small inner tooth a little beyond the middle, and with the outer tooth strongly curved inward.

Frons and vertex finely tessellate and rather strongly shining, the frons with numerous, but well separated, very fine punctures. Face below antennæ polished and very sparsely and indistinctly punctured. Cheeks indistinctly tessellate and shining, and with numerous but very fine punctures. Mesonotum shining, polished on disk, finely tessellate around the margins and on anterior part of scutum, and with numerous but well separated, very fine punctures, which become sparse on posterior part of disk of scutum. Prothorax, propodeum, and pleura finely tessellate and shining, the pleura with numerous fine punctures. Abdomen with the usual microscopic lineolation. Pubescence very much as in the male, the scopa of the hind tibiæ rather short and of ordinary density.

Head and thorax very dark green, the propodeum slightly bluish green. Base of mandibles, marks on clypeus, and lateral face marks lemon-yellow. Mandibles otherwise rather pale ferruginous or reddish. Labrum dark brown, clypeus piceous, with a slender median vitta, fine marginal line at summit of disk, and sometimes a rather large spot on each side of disk anteriorly, yellow; the median pale vitta and dorsal transverse line uniting to form a T or anchor-shaped mark. Lateral face marks in form of a vertical rather narrow triangle, more than twice as high as wide at base, and with the acute to rather blunt apex ending at level of lower margin of antennal sockets. Remainder of face above clypeus dark green. Posterior corners of pronotum each with a large cuneiform mark, sometimes nearly meeting medially, and anterior border of pronotum yellow, but tubercles entirely dark or showing only a trace of yellow at apex. Abdomen piceous above and beneath, the pygidium ferruginous brown. Tergites 2 to 5 each with a narrow even basal yellow band, narrowly interrupted in middle, reaching to lateral foveæ on 2 and not quite to lateral margins on other segments, the band on 5 very narrow and concealed when segment is retracted. Labio-maxillary structure brown, the glossa paler brown. Antennæ piceous, the flagellum uniformly dark, the scape yellow except above on distal half. Legs piceous, the front tibiæ anteriorly and all the tarsi yellow (in one specimen on left side only the middle and hind basitarsal joints are piceous). Tegulæ hyaline, with a yellow spot at base. Wings milky hyaline, the subcosta brown, the stigma yellowish with deeper yellow margins, the remainder of venation very pale.

Length about 6.5 mm.

***Perdita excisa* Timberlake**

1 ♀, Dulzura, San Diego County, California, 2800 feet altitude (W. S. Wright). This species will be described in my report on the California species of *Perdita*. It belongs to the group of *P. interrupta* Cresson.

***Perdita zebrata* Cresson**

1 ♂, 3 ♀, New Mexico (no other data); 1 ♂, Pueblo, Colorado, altitude 4700 feet, August 9, 1920 (Frank E. Lutz); 1 ♂, La Junta, Colorado, altitude 4100 feet, August 12, 1920 (Frank E. Lutz); and 1 ♀, Canfield, Colorado, August 15, 1922 (Frank E. Lutz). *Zebrata* forms the type of a large group of southwestern species, which almost always have the abdomen yellow with four or five dark bands. This group is the subgenus *Neoperdita* Ashmead.

In the American Museum there is also another species of the *zebrata* group, represented by a single rather poor specimen, labelled New Mexico, without other data. Both Dr. Cockerell and myself consider this an undescribed species, similar in many respects to *P. stottleri* Cockerell, but much smaller. On account of the poor material and incomplete data it does not seem advisable to describe it at this time.

***Perdita dasyliirii* Cockerell**

19 ♀, 1 ♂, Sabino Basin, Santa Catalina Mts., Arizona, at an altitude of about 3800 feet, July 8 to 20, 1916 (Frank E. Lutz and J. A. G. Rehn).

All of the specimens were taken on *Agave palmeri*.

The female from this locality was described by Dr. Cockerell as *P. nolinæ*, but the association of the females with a typical male of *dasyliirii*, collected at the same time, establishes the synonymy without doubt, a fact which I had suspected before examining the above material, on account of the close similarity to *P. rhois* Cockerell in both sexes. The synonymy, however, is complicated by the fact that *P. dasyliirii* was originally described from the supposed female and male, so that it is necessary to restrict the name to the supposed female which was actually a male and exclude the second male as belonging to another as yet apparently unnamed species.

P. dasyliirii belongs to the *rhois* group, apparently restricted to the southwestern states and Lower California, and characterized by the large very broad stigma and the well-marked antigeny of the sexes.

***Perdita larreae* Cockerell**

1 ♀, Santa Cruz village, Cobabi Mts., Arizona, August 10 to 12, 1916, at about 3100 feet elevation (Frank E. Lutz and J. A. G. Rehn). The bee was "swept from greasewood (*Covillea tridentata*)."

At first I considered the above specimen to be an undescribed species but later concluded that it is the previously unknown female of *P. larreae*. If this is actually the case, it seems equally certain that *P. larrearum* Cockerell is the female of *P. marcialis* Cockerell. The whole matter, however, is perplexing and needs clarification by careful field observations or by much more abundant material than has been as yet assembled.

The female runs in Cockerell's table (1896) to couplet 3, where it agrees with *P. marcialis* Cockerell except in sexual characters and in having the thorax brownish or ferruginous yellow. It differs from *P. larrearum* Cockerell by having the head, thorax, and abdomen brownish

or ferruginous yellow, with a transverse blackish band on vertex and a broad transverse dark green band on mesosternum, the mesonotum nearly nude, etc. The yellow parts of the *P. larrea*, male, and of *P. marcialis*, are deep orange-yellow and quite different from the more or less ferruginous or brownish pale parts of *P. larrearum* or *P. larrea*, female, but I believe this difference is only sexual. *P. larrea* is the type of the subgenus *Perditella* Cockerell. The group is apparently restricted to the Southwest and is characterized by the very peculiar venation, marked antigeny of the sexes, and by the peculiarly half milky and half clear hyaline wings of the female, etc.

FEMALE.—General form small and ordinary. Head a little longer than wide and rather well rounded on sides and above. Cheeks rather narrow. Inner orbits of eyes nearly straight and parallel. Mandibles rather slender for a female *Perdita*, rather acute and simple at apex, and reaching nearly to far margin of labrum. Clypeus convex but not prominent and extending a short distance in front of ocular line; disk somewhat broader than high, the sides straight and extending obliquely nearly to inner side of base of mandibles, and the summit not very broadly truncate between dog-ear plates; lateral extensions feebly differentiated, being extremely broad and continuous with disk on inner side, rather strongly reflexed along anterior margin and visible in large part in frontal view of head. Dog-ear plates distinctly more than twice as high as wide, strongly oblique and diverging below, and very acute at lower end. Lateral plates of face a third narrower below than at level of antennæ and at level of summit of clypeus each covering about one-fourth the total width of face. Prominence between antennæ low but distinctly tectiform and carinate medially above the level of middle antennal sockets, the carina extending nearly to middle of frons and replaced above the middle of frons by a fine impressed median line, which reaches to anterior ocellus. Abdomen very broadly oval, hardly more than one-half longer than wide, depressed above, the pygidium rather narrow and broadly rounded at apex. Membrane of wings with rather sparse obsolescent setæ in apical field; stigma very large and broad, being fully as wide and almost as long as first submarginal cell, and emitting radius near the middle. Marginal cell extremely oblique to costal margin, squarely truncate and appendiculate at apex, and with the substigmal part about one-half as wide and more than twice as long as poststigmal part; first and second abscissæ of radius bent almost at right angles with each other, the metacarpus a little shorter than the apical truncation of cell. Second submarginal cell triangular, moderately bulging on outer side, and with the intercubiti meeting above on radius where the latter is bent. Third discoidal cell complete. First recurrent vein, first intercubitus, and second abscissa of radius forming an almost straight line; second recurrent vein exactly interstitial with the second intercubitus. Claws rather small and simple.

Head and thorax moderately shining, and finely, rather delicately but distinctly tessellate. Cheeks rather more delicately tessellate than other parts. Clypeus smooth except at summit. Prothorax strongly shining, smooth above and very delicately tessellate on the pleura. Sides of face, middle of frons, cheeks, mesoscutum, and mesopleura with very fine, sparse, obscure punctures. Abdomen shining and with an indistinct microscopic lineolation. Pubescence white and very sparse, longest and

thickest on legs and at apex of abdomen, sparse and rather short on cheeks, pleura, and mesosternum. Frons with a few very short appressed hairs on each side of middle below and the foveæ filled with fine short appressed white hair. Scopa very sparse, with the hairs on outer side of tibiæ short, those on inner side two or three times longer.

Head, thorax, and legs ferruginous yellow, the clypeus and abdomen a little paler or testaceous yellow. Frons with a nubilous piceous spot on each side extending obliquely from foveæ (and enclosing foveæ) toward antennal sockets. Vertex of head with a broad transverse black band, shining with a slightly metallic greenish luster, and squarely and broadly emarginate medially behind ocelli. Anterior end of mesoscutum with a greenish luster. Posterior part of mesosternum with a broad, very dark green, transverse band, reaching slightly on to the pleuron on each side. Legs concolorous with body, but hind tibiæ and base of hind tarsi above, fuscous. First two tergites, except black lateral foveæ of 2, sides of tergite 3, base of tergites 3-5, and pygidium clearer yellow than rest of abdomen. Venter dark brown or fuscous on last four segments and at middle of first two, but the reflexed sides of the tergites pale. Labio-maxillary structure ferruginous brown. Mandibles almost concolorous with face, with the apices a little reddish. Antennæ nearly concolorous with face, except that the flagellum is broadly dark brown or fuscous above. Tegulæ almost clear hyaline, but concolorous at base with thorax. Wings hyaline, clear in apical field, but milky to end of venation, the hind pair entirely milky; veins and stigma very pale yellow, with margins of stigma a little deeper yellow.

Length about 3.5 mm.

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BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. IV.¹

BY ROBERT CUSHMAN MURPHY

Procellariidæ

***Pterodroma rostrata* (Peale)**

Procellaria rostrata PEALE, 1848, 'U. S. Explor. Exped.,' VIII, p. 296 (Tahiti, Society Islands).

Specimens from the Society Islands (Tahiti, March, September, and December, 1921, April, 1923; Moorea, June and July, 1921); Marquesas Islands (Hivaoa, November, 1922).

Birds just beginning to excavate their burrows were captured on March 11; well-grown young were taken from nests at Moorea on July 2 and 8, their plumage being like that of adults.

The specimens exhibit considerable variation in the amount of brown along the sides of breast and belly. In other respects they are very uniform. As will be pointed out below, there is no reason for confusing this species with *Pterodroma parvirostris* (Peale), or for regarding the two as subspecifically related.

MEASUREMENTS.—(10 males): Wing, 288–308 (297); tail, 110–120 (115); exposed culmen, 36–39 (37); bill from gape, 46–49 (48); tarsus, 47–50 (49); middle toe with claw, 56–64 (60) mm.

5 females: Wing, 286–302 (295); tail, 107–120 (114); exposed culmen, 35–39, (37); tarsus, 45–49 (47); middle toe with claw, 57–61 (58.6) mm.

Nesting birds had worn down their claws, as is common among burrowing petrels. This accounts for the high range in the measurement "middle toe with claw."

***Pterodroma becki*, new species**

SPECIFIC CHARACTERS.—Resembling *Pterodroma rostrata* in color pattern and general proportions, but more than one-fourth smaller, with a relatively weaker bill.

ADULT FEMALE.—Dorsal surface, head, neck, breast, and quills, blackish brown (No. 3 of Ridgway where most intense); feathers of back showing indefinite fuscous-black margins, those of the breast approaching fuscous, perhaps because of fading; concealed portions of the feathers throughout dark plumage, grayish; ventral surface, caudad from the line of demarcation bounding the dark breast, white, laterally washed

¹Previous papers in this series comprise American Museum Novitates, Nos. 115, 124 and 149.

with blackish brown; under tail coverts proximally and centrally pure white, the lateral feathers with more or less blackish brown on their outer webs, the longer central coverts distally fuscous-black on both webs; shafts of wing and tail quills basally white, the inner vanes of the remiges grayish but nowhere white. Iris, brown; bill, black; legs and feet, particolored (black and flesh) in the usual style of white-breasted members of the genus. Outermost primary longest, with an increasing proximal gradation of the quills; tail, of 12 rectrices, rounded-cuneate as in *P. rostrata*.

TYPE.—No. 235,376, Amer. Mus. Nat. Hist.; ♀ ad.; lat. 155° E., long. 3° S; January 6, 1928; R. H. Beck.

MEASUREMENTS.—Type: Wing, 245; tail, 98; exposed culmen, 25.6; bill from gape, 35; width of maxilla at base, 11.7; tarsus, 36; middle toe with claw, 45 mm.

RANGE.—Known only from the type locality, which is east of New Ireland and north of Buka and Bougainville Islands, Solomon Group.

The type skin is the only specimen. The new bird is a miniature edition of *Pterodroma rostrata*, except that the bill seems to be relatively, as well as absolutely, more slender. The size distinction being greater than any yet recognized as subspecific among petrels, I have assigned specific rank to the new form.

It should be stated that while *Pterodroma becki* bears so close a resemblance to *rostrata*, it is not in any particular way reminiscent of *Pterodroma parvirostris*. Mathews (1927, Syst. Av. Australasianarum, p. 119) has grouped *rostrata* and *parvirostris* as races of one species, a step taken, perhaps, on the evidence of Cassin's incomprehensible plate and in the absence of adequate specimens for comparison.

It seems appropriate that the name of Rollo H. Beck, who has collected more Tubinares than any other man, should be commemorated within the group, and the receipt of this very interesting undescribed petrel gives an opportunity to pay him a well-deserved tribute.

***Pterodroma parvirostris* (Peale)**

Procellaria parvirostris PEALE, 1848, 'U. S. Explor. Exped.,' VIII, p. 298 (Pukapuka Island, Tuamotu Group); CASSIN, 1858, idem, Atlas, Pl. XL.

Specimens from the Line Group (Christmas Island, February, 1921); Marquesas Islands (Huapu and Motuiti, September, 1922; Hatutu, September and October, 1922; Fatuhuku, November, 1922); Phoenix Islands (Phoenix, Canton, and Hull, March, 1924).

Nesting adults, and young in all stages of development, were taken at Christmas Island between February 10 and 16. Nestlings which had molted most of their down were found at Hatutu Island, Marquesas Group, during September and October.

Peale's type is said to have come from Pukapuka (Henuake, Honden,

or Dog) Island, in the eastern part of the Tuamotu Archipelago. The members of the Whitney Expedition did not, however, encounter the species during their extensive work among the Tuamotus.

All our specimens apparently belong to a single race, those from the different insular groups showing no constant variation in either appearance or dimensions.

Pterodroma parvirostris is readily distinguishable from *P. rostrata* by the following characteristics: smaller size, with overlapping in no dimension except length of tail; blacker coloration throughout the dark parts of the plumage; whitish throat; white infraorbital stripe, with a suggestion of a similar white line above the eye; barred under tail coverts; disproportionately small legs and feet. With regard to the last, the tarsus of *parvirostris* is even shorter than that of *becki*, although the latter is much the smaller bird. The graph (Fig. 1) shows the size relationship of the three species. *P. parvirostris* is probably not closely akin to either of the other two, but may have its nearest affinities with the *heraldica* group of petrels.



Fig. 1. Relative size and proportions of (a) *Pterodroma rostrata* (average of 10 specimens), (b) *P. parvirostris* (average of 10 specimens), and (c) *P. becki* (1 specimen). The distinction between *rostrata* and *becki* is one of size; *parvirostris* differs markedly from both in proportions, as is shown by the relation of the broken line (b) to the nearly parallel curves for the two other species.

The dark parts of the plumage in *P. parvirostris* are sooty, with little or none of the rich brown or fuscous appearance so characteristic of *rostrata*. The concealed bases of the feathers on the throat and upper breast, however, are white, and the whiteness of the throat patch seems to be largely a question of wear. All specimens show at least a suggestion of this patch, and in many the triangular white area is large and practically immaculate.

The down of newly hatched chicks is close to dark Quaker drab in color, slightly lighter on the ventral surface. The hue of the secondary

down, which fades with age, belongs in the neutral gray series, between the deep and the pale, of Ridgway.

The following measurements are based upon skins from all of the localities represented in the collection.

MEASUREMENTS.—(15 males): Wing, 272–284 (278); tail, 106–114 (111); exposed culmen, 27–30 (28.7); tarsus, 33–36 (34); middle toe with claw, 44–47 (45.7) mm.

5 females: Wing, 265–289 (275); tail, 108–115 (110.4); exposed culmen, 28–30 (29); tarsus, 32–35 (33.5); middle toe with claw, 43–46.5 (44.5); mm.

***Puffinus lherminieri polynesiae* Murphy**

Puffinus lherminieri polynesiae MURPHY, 1927, Amer. Mus. Novit., No. 276, p. 8 (Tahiti, Society Islands).

The range of this recently described form is extended into the Tonga Group by a male collected five miles east of Fatumanga Island on August 8, 1925. Its measurements are: Wing, 204; tail, 80; exposed culmen, 29; tarsus, 40; middle toe with claw, 41 mm.

A female from Huapu Island, Marquesas Group, likewise represents a new locality.

***Puffinus lherminieri nugax* Mathews**

Puffinus lherminieri nugax MATHEWS, 1912, 'Birds Austral.,' II, p. 72 (off Townsville, Queensland); MURPHY, 1927, Amer. Mus. Novit., p. 12 (Melapav Island, New Hebrides).

Four additional specimens of this hitherto little-known shearwater were taken at sea, 30 miles east of Melapav Island, on January 28, 1927, by Dr. Drowne and Messrs. Beck and Hicks, of the Whitney Expedition. These confirm the distinctness of the subspecies. A male and three females are in a more worn state of plumage than the neotype, but they show all the characteristics of the race as regards the peculiar pattern and the uniformly large size.

Following are the dimensions of all the known specimens, comprising the neotype and the four here recorded (1♂, 4♀): Wing, 207–213 (209); tail, 73–77 (75.5); exposed culmen, 29–31 (30.1); width of bill at base, 11–12 (11.7); tarsus, 41–43 (42); middle toe with claw, 43–46 (44.5) mm.

Hydrobatidæ

***Fregatta grallaria titan*, new subspecies**

Fregatta grallaria, subspecies, MURPHY, 1924, Amer. Mus. Novit., No. 124, p. 9 (Rapa Island, Austral Group).

SUBSPECIFIC CHARACTERS.—Differs from *Fregetta grallaria grallaria*, of the Juan Fernandez Islands, eastern South Pacific, in its much larger size in all dimensions.

TYPE.—No. 193,197, Amer. Mus. Nat. Hist.; ♀ ad., nesting; Rapa Island, Austral Group, South Pacific; February 15, 1922; R. H. Beck.

RANGE.—Known only from Rapa and the adjacent waters.

Measurements of a larger series than was made use of in the paper cited above give the figures recorded below. Females slightly exceed males in size, as indicated by the averages and by the fact that all the maxima are derived from females.¹

	Wing	Tail	Culmen	Tarsus	Middle Toe with Claw
17 ♂	181	82.4	15.4	40.6	25.1
10 ♀	184.1	83.8	15.5	41.6	25.8
Minimum of the series	177	78	15	39	23.6
Maximum of the series	188	89	16.3	43	27

Rapa, or Oparo, is a southern outlier of eastern Polynesia, situated well to the southward of the Tropic of Capricorn. Doubtless the extreme isolation of the island as a breeding station serves to account for the distinctness of the form of *Fregetta grallaria* which occurs there. Rapa specimens, for example, average about 16 per cent larger than specimens of the typical form from Juan Fernandez. They are also larger, though less pronouncedly so, than the bird of Lord Howe Island, which Mathews has named *insularis*. Further details concerning the subspecies here described as *titan* will be found in the paper cited above.

¹In this connection it is of interest that twelve females of *Fregetta grallaria grallaria* from Juan Fernandez also average larger than fifty-one males.

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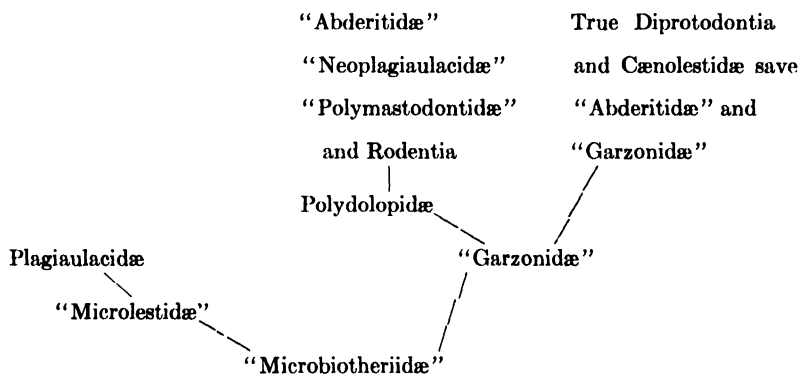
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AFFINITIES OF THE POLYDOLOPIDÆ

BY GEORGE GAYLORD SIMPSON

The family Polydolopidæ includes a number of South American genera, all described by Florentino Ameghino, which are commonly referred to the order Multituberculata. In attempting to unravel the history of this great order it is necessary to reach some definite opinion as to the relationships of these genera, and their importance is further enhanced by the extraordinary phylogenetic position assigned to them by Ameghino himself. His views are summed up in the following diagram:¹



According to this view the group Multituberculata of other authors is diphyletic, the true plagiulacids being derived from the ?Eocene to Miocene microbiotheres (didelphids, somewhat aberrant) by way of the Triassic "microlestids" (microcleptids); and the Cretaceous and Paleocene multituberculates from the microbiotheres by way of the Miocene (possibly also Eocene and Oligocene) "garzoniids" (epanorthines) and Eocene polydolopids. Ameghino considered the polydolopids as related to three groups: Multituberculata, Cænolestoidea (and through them, the Australian Diprotodontia), and Rodentia.

¹Simplified from Ameghino 1903, p. 188 (see references at end of paper).

This highly original phylogeny, which transcends so many of the accepted lines of zoological classification and closely links three groups so unlike that modern classifications refer them to three separate sub-classes, has had very little influence on scientific thought. Yet most later writers, while rejecting the collocation of groups which was the chief point of Ameghino's argument, have accepted his classification to the extent of retaining the Polydolopidæ where he put them, in the Order Multituberculata (Allotheria). They have copied his classification but passed over the abundant, and fundamentally sound, arguments of Ameghino that the polydolopids were really intimately related to the cænolestids. His phylogeny makes them descendants of one group of cænolestids—Epanorthinæ—and ancestors of another—Abderitinæ.

The only detailed objection to placing the Polydolopidæ in the Multituberculata is that of Gregory (1910, p. 211-4) who considers the resemblances to multituberculates (and rodents) as convergent and suggests tentatively that the polydolopids were highly modified cænolestoids. The whole problem is of such outstanding importance that as thorough a reconsideration, as the known facts will permit, is necessary.

The Patagonian forms referred to the Allotheria by Ameghino include fourteen genera, ranging in age from Eocene to Pliocene, according to the present accepted views, or Cretaceous to Oligocene according to Ameghino. Eight of these constituted the Polydolopidæ proper, all from the *Notostylops* Beds or Casa Mayor Formation. This deposit was placed by Ameghino in the Upper Cretaceous, but it is now unanimously referred to the Tertiary although opinions as to exact age vary from Paleocene to Upper Eocene. One of the most important arguments for placing it in the Paleocene has been the supposed presence of multituberculates, but this evidence is quite invalid. Exact correlation is impossible at present but the Casa Mayor is almost surely of true Eocene age and probably rather late Eocene.

The genera not referred to the Polydolopidæ were distributed in the "Promysopidæ" and in two families based on real multituberculates (not from South America). For convenient reference all of these genera are briefly listed as they were classified by Ameghino:

FAMILY POLYDOLOPIDÆ:

Polydolops. (Type *P. thomasi*; four other species). Genus based on an upper jaw, but several lowers later referred. Best known of all genera here considered. CASA MAYOR. Figs. 1D, 2C, 6B.

Eudolops. (Unique species, *E. tetragonus*). Based on a single upper molar. CASA MAYOR. Fig. 7A.

Pliodolops. (Unique species, *P. primulus*). Two associated upper molars. CASA MAYOR. Fig. 7B.

Amphidolops. (Type *A. serrula*; one other species). Two isolated lower molars referred to distinct species. CASA MAYOR. Fig. 1F.

Orthodolops. (Unique species, *O. sciurinus*). Based on a right ramus with P_3 - M_4 . CASA MAYOR. Fig. 1E.

Pseudolops. (Unique species, *P. princeps*). Based on various upper and lower teeth of uncertain association. CASA MAYOR. Figs. 1G, 7C.

Archæodolops. (Unique species, *A. clarulus*). Left ramus with P_2 - M_4 . CASA MAYOR. Fig. 3A.

Anadolops. (Unique species, *A. thylacoleoides*). Left ramus with M_2 - M_4 , so worn as to be uncharacteristic. M_4 erroneously stated to be absent.² CASA MAYOR. Fig. 3B.

FAMILY "NEOPLAGIAULACIDÆ" (including in addition to the following, all the smaller Cretaceous and Paleocene true multituberculates of Europe and North America):

Anissodolops. (Unique species, *A. serrifer*). M_{2-3} mentioned in description, only isolated M_3 figured. Generic distinction from *Polydolops* or *Pseudolops* not clear. CASA MAYOR. Fig. 5B.

Eomannodon. (Unique species, *E. multituberculatus*). Single lower molar figured. PATAGONIAN (MIOCENE). Fig. 5C.

FAMILY "PROMYSOPIDÆ":

Promysops. (Type, *P. acuminatus*; one other species). Based on a fragment of lower jaw without any teeth. A lower molar later referred, but basis for reference uncertain. Second species based on an incisor from the *Astraponotus* Beds (Oligocene). CASA MAYOR. Fig. 5A.

Propolymastodon. (Type *P. carolo-ameghinoi*; one other species). Type a left ramus with all cheek teeth, and an isolated incisor. A second specimen with M_{1-3} referred to a distinct species. CASA MAYOR. Figs. 1H, 4.

FAMILY "POLYMASTODONTIDÆ" (including *Tæniolabis* of the North American Puerco in addition to the following):

Mannodon. (Unique species, *M. trisulcatus*). A single molar figured. SANTA CRUZ (MIOCENE). Fig. 5D.

Paradoxomys. (Unique species *P. patagonicus*). Based on an incisor. ENTRERIAN (PLIOCENE).

Ameghino's Polydolopidæ together with *Anissodolops* and *Propolymastodon*, which appear properly to belong to this family, will first be considered. As a group the various *-dolops* genera and *Propolymastodon* are characterized by the presence of an enlarged, procumbent incisor; reduction of the premolars; presence of a much enlarged, laterally compressed, trenchant lower cheek tooth (M_1); elevation and compression of the anterior part of the succeeding tooth (M_2), broad, low, basined

²Throughout this paper the tooth designations of Ameghino, who called all the cheek teeth molars and numbered them consecutively from one to seven, are translated into the more generally understood notation which assigns the ancestral formula P_3 ; M_1 to the Marsupialia.

M₃₋₄ with multicuspidate rims; two trenchant upper cheek teeth (P³ and M¹); and multicuspidate M²⁻⁴.

One of the chief reasons for the rather general acceptance of the reference of the Polydolopidae to the Multituberculata is undoubtedly the very *Tæniolabis*-like aspect which Ameghino has given to the mandible of *Propolymastodon* in his widely copied restoration. One of the most striking characters of the true multituberculates is the absence

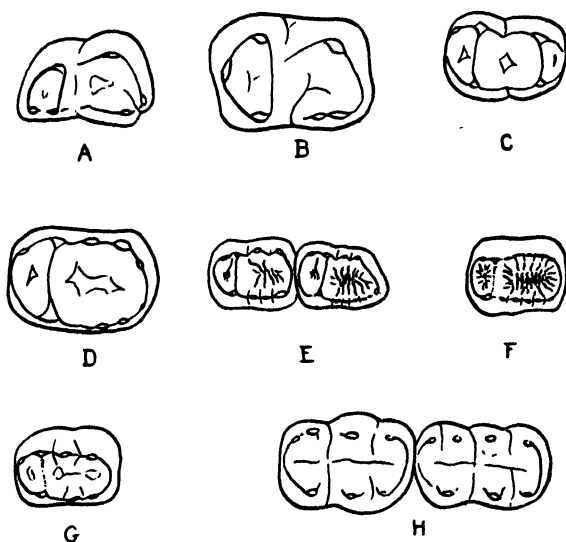


Fig. 1. Right lower molars of cænolestoids. A, *Halmarhiphus*, M₂, ×5. B, *Acdestis*, M₂, ×5. C, *Abderites*, M₂, ×5. D, *Polydolops*, M₂, ×5. E, *Orthodolops*, M₃₋₄, ×3. F, *Amphidolops*, M₃, ×3. G, *Pseudolops*, M₃, ×3. H, *Propolymastodon*, M₃₋₄, ×3. A-D are original, based on specimens in the Bavarian State Collection, Munich, and the American Museum of Natural History, New York. E-H are redrawn after Ameghino.

of an angular process, a continuous wide pterygoid crest taking its place. A similar condition is seen in the restoration of *Propolymastodon*, but an examination of all the published figures and descriptions shows that the known material may, indeed, permit such a restoration but certainly does not authorize nor necessitate it. The crucial parts are absent, and a few strokes of the pen, based on even better grounds than those of Ameghino, suffice totally to change the aspect of this jaw from multituberculate-like to cænolestoid-like (Fig. 4). Furthermore, *Polydolops*, an indispu-

tably close relative of *Propolymastodon*, clearly had an inflected angle thoroughly cænolestoid in character.

The horizontal ramus in the Polydolopidæ is fairly long and slender with alveolar and lower borders roughly parallel and quite unlike the Multituberculata in aspect. Furthermore, and more important, there are two mental foramina, one beneath the middle of the premolar series or of the diastema and one beneath M_1 or M_2 . This is the usual primitive marsupial arrangement and contrasts fundamentally with the single mental foramen just back of the incisor in the Multituberculata.

It is, however, the lower teeth that must bear the chief burden of argument, as they are the best known and most characteristic. The enlarged incisors have no independent value as evidence of affinities, similar ones having been acquired at least six times quite independently within the Class Mammalia. They agree thoroughly however with the cænolestoid resemblances of the other known parts. According to Ameghino there is evidence that *Propolymastodon* had two pairs of lower incisors, which is of interest in view of the fact that even in the Jurassic no multituberculate has any vestige of more than one pair whereas the cænolestids may have from one to four. The reduction of the ante-molar teeth is carried farther than in other cænolestoids, but in the same direction. *Propolymastodon* appears to have lost the canine and all the premolars. *Polydolops* has one small premolar, while *Archæodolops* has at least two, and possibly more, which closely resemble those of the Abderitinæ. This occurrence of two or more small apparently functionless premolars is another marked difference from any known multituberculate and out of keeping with the whole evolutionary trend of the Multituberculata.

The shearing tooth itself is unlike that of the multituberculates in contour and structure. It may have a coarsely notched edge (*Polydolops*) or a finely serrate one (*Propolymastodon*) or may be quite smooth (*Archæodolops*). It does not have grooved or ridged lateral surfaces as in the Abderitinæ, Multituberculata (save *Tæniolabidæ*) and many macropids. This tooth is apparently homologous with the normal molariform M_1 of the Cænolestinæ (cf. *Cænolestes*, *Halmarhiphus*), as was first pointed out by Ameghino, and hence is not homologous with the shearing tooth in recent macropids, which is P_3 . The first step in modification is seen in the Epanorthinæ (Fig. 2A) in which the heel is normal and all the trigonid cusps are retained, but the trigonid is greatly elongated and compressed, forming a shearing edge. In the Abderitinæ, universally admitted to the cænolestoids, the anterior part of the tooth is more elevated, has lost its heritage of three cusps, and has become serrate; while the

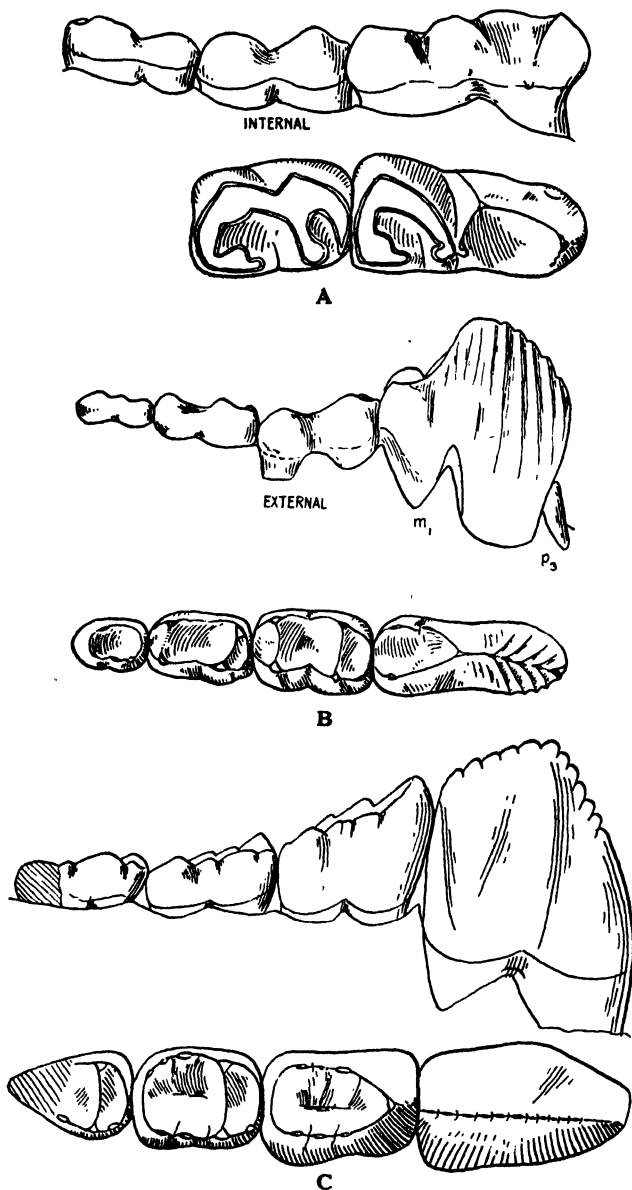


Fig. 2. A, *Accestis*, left lower cheek teeth, crown and internal views. B, *Abderites*, right lower cheek teeth, crown and external views. C, *Polydolops*, right lower cheek teeth, crown and external views. All $\times 5$. A and B original, based on specimens in the Bavarian State Collection, Munich. C, redrawn after Ameghino with reference to original specimens in the Bavarian State Collection.

heel is retained and is still basined, but altered in character by the advancing specialization of the whole tooth (Fig. 2B). The polydolopids show the next structural stage in such a progressive shearing modification. In them M_1 has lost the basined heel and M_2 has an elevated trigonid which is beginning to be involved in the enlarging shearing apparatus (Fig. 2C).

This is not a natural phylogenetic sequence for, with the exception of the very inadequately known *Progarzonia*, all of the known undoubted Cænolestidæ are younger than the Polydolopidæ. Nevertheless it appears to be a legitimate example of the survival of slightly modified structural stages even after the extinction of the most specialized phylum of the



Fig. 3. A, *Archæodolops*, external view of left lower jaw, $\times 1.5$. B, *Anadolops*, external view of left M_{2-4} . $\times 1$. Both redrawn after Ameghino.

superfamily. Other examples may be found in almost any other group of mammals; it is, indeed, almost the general rule in the evolution of vertebrates that *more specialized phyla tend to become extinct before the less specialized ones of the same group*. Similarly, the living cænolestids are more primitive than the majority of the known Miocene forms and represent a structural stage ancestral to the latter. Forms more primitive than the living ones do occur in the Miocene (*Halmarhiphus* etc.) and the absence of analogous annectant types in the Casa Mayor may be felt seriously to weaken the argument. The difficulty is more apparent than real, however, for no forms which could be ancestral to the Santa Cruz ones appear in the Casa Mayor (again with the exception of the very little known *Progarzonia*) and this absence of mammals which obviously must have been present in South America at the time is quite as difficult to explain as the absence of the actual connecting types between the Polydolopidæ and the Cænolestidæ. The Casa Mayor represents only a fauna of rather limited area and of one facies, and even if present these small and rather rare mammals might easily fail to appear in collections. In fact, the true annectant forms must be pre-Casa Mayor and the only definable pre-Casa Mayor mammal yet known from South America is *Proteodidelphys*, known from a single specimen. Under such conditions

negative evidence should be given no weight. It is another case where the often lamented imperfection of the geological record forces one to have recourse to the methods of comparative anatomy, in this case especially to the comparative anatomy of the rich Miocene Santa Cruz fauna.

The first molar having been converted into a shearing tooth, three more or less molariform teeth remain. As throughout their whole known anatomy, the *Polydolopidæ* here differ again fundamentally from any multituberculates, for in the long line of plagiaulacoid multituberculate genera from the Jurassic into the Eocene none has more than two molariform teeth in either jaw.

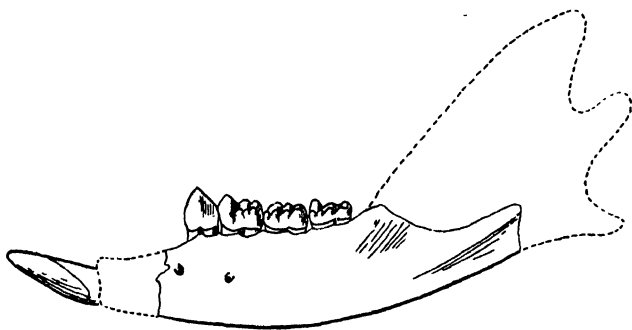


Fig. 4. *Propolymastodon carolo-ameghinoi*, new restoration of left lower jaw, $\times 1$. Parts in continuous lines redrawn after Ameghino.

M_3 is most suitable for comparison, M_2 being obviously modified by its participation in the shearing edge and M_1 frequently being somewhat degenerate. In M_3 of *Polydolops*, *Archædolops*, and some of the less known genera the student of dental evolution would at once see traces of a tuberculo-sectorial ancestry were it not for the apparently anomalous condition of the trigonid. This has a single, higher *internal* cusp and two lower *external* cusps—the opposite of the tuberculo-sectorial type. The same structural series which appears to elucidate the mystery of the origin of the shearing tooth also explains this peculiar molar type, however (Fig. 1).

In *Halmarhiphus*, probably the most primitive of all known cænolestoids, the molars are typically tuberculo-sectorial and are, furthermore, almost exactly of the didelphid pattern. There is a normal tricuspid trigonid and a basined heel with three cusps, the hypoconulid being posterointernal and close to the entoconid, a character highly character-

istic of the Didelphiidæ and often seen in the less specialized marsupials of other families as a heritage character. With relatively slight variations the *Halmarhiphus* pattern is typical of the Cænolestinae, which have no true shearing teeth (Fig. 1A). In the Epanorthinae, with their beginning shearing adaptation, M_{2-4} are also beginning to specialize, the crowns being lower, broader, more adapted for crushing and grinding. The paraconid is no longer internal but *anterior* (Fig. 1B). In the Abderitinae, which, as has been shown, represent the next structural stage in modification for shearing, the molars are still more specialized in the same direction. The heel is very long and broadly basined, the trigonid relatively low, with the paraconid *external* (Fig. 1C). From this type to that of the

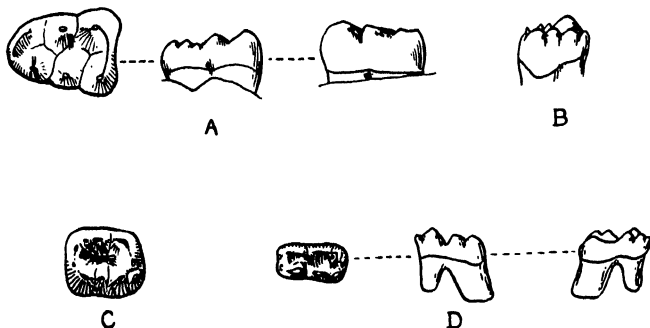


Fig. 5. A, *Promysops* (doubtfully referred), crown and side views of lower molar, $\times 3$. B, *Anissodolops*, external view of right M_3 , $\times 3$. C, *Eomannodon*, crown view of molar, $\times 7.5$. D, *Mannodon*, crown and side views of lower molar, $\times 3$. All redrawn after Ameghino.

less specialized polydolopids is a short and obvious step. Like the shearing teeth, the grinding teeth of the Polydolopidæ are, except for relatively unimportant details, simply a further development of the abderitine type. (Fig. 1D, 1G). The trigonid is absolutely identical in character. The heel is still more broadly basined and has additional cusps (in the less specialized forms only one more)—exactly the sort of change which has repeatedly occurred in other mammalian groups in correlation with similar specialization of food habits. Continuing the same sort of change, the transition to the other *-dolops* genera is slight. *Orthodolops* and *Amphidolops* (Fig. 1E, F) retain the abderitine trigonid, but the talonid rim becomes broken up into numerous small cuspules and the enamel of the basins is rugose. The *Propolymastodon* M_{2-4} are of almost the same

pattern as *Polydolops*, *Pseudolops*, and *Archæodolops*, with two external and one internal trigonid cusps and four chief talonid cusps, but judging from Ameghino's figures the distinction between trigonid and talonid tends to disappear. *Anissodolops* may be more on the order of *Orthodolops*, but the preservation is not sufficiently good for sound decision.

The polydolopids thus are essentially unified with regard to lower molar structure and are clearly linked structurally with the Abderitinæ and through them eventually with the primitive tuberculo-sectorial type. The resemblance to the Multituberculata in lower molar structure is entirely superficial and lies only in the fact that they have a number of cusps roughly arranged in two rows, as have a host of other quite unrelated mammals. These basined molars with distinct trigonid and talonid and cuspidate rims are as unlike the true multituberculate molars as is well possible.

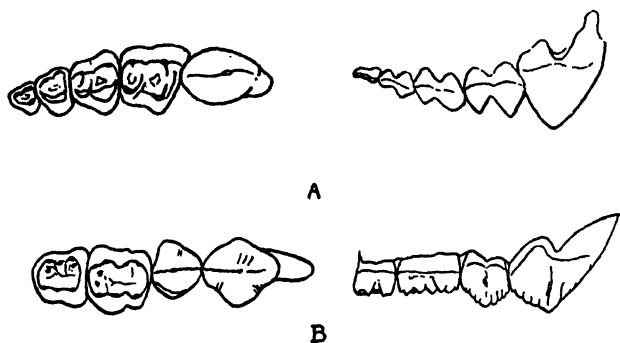


Fig. 6. A, *Epanorthus*, crown and external views of right upper cheek teeth, $\times 2$. B, *Polydolops*, crown and external views of right upper cheek teeth, $\times 2$. A, original, after specimens in the American Museum of Natural History. B, redrawn after Ameghino.

The upper molars are less well known, both in the Polydolopidæ and in the Cænolestidæ, and their interpretation is much more difficult. If, however, their relationship to the cænolestidæ is less easily demonstrable, their differences from the Multituberculata are even more obvious.

There were two shearing teeth, both very like the main lower shearing tooth, with simple, ungrooved, compressed crowns, with or without a cuspidate edge, and with no heels or accessory cusp rows. Ameghino considered these teeth as P^3 and M^1 (" M^{3-4} "), which must be correct although the whole series is not known in association. Unlike the

analogous lower tooth (M_2), M^1 retains no trace of its probable ancestral condition. Nothing save reasonable inference bridges the gap between the typical molariform epanorthine M^1 and the highly modified homologous tooth of the polydolopids. The abderitine series is not sufficiently well known to be of conclusive value, but it does not appear to be as nearly transitional structurally as in the case of the lower teeth. M^{2-4} also present difficulties, although they are very unlike the two multituberculate upper molars and could be derived from the cænolestid ones by broadening and cusp proliferation, thoroughly in keeping with the apparent evolutionary trend of the group.

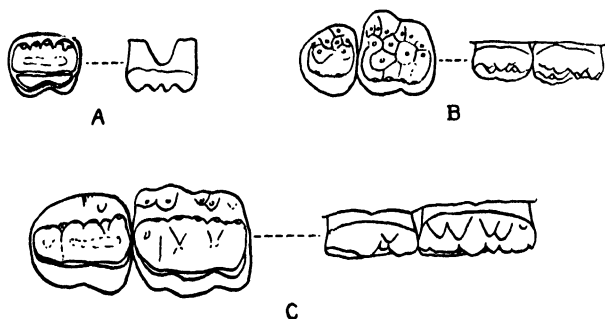


Fig. 7. A, *Eudolops*, upper molar, crown and external views, $\times 1.5$. B, *Pliodolops*, Crown and external views of right M_{3-4} , $\times 2$. C, *Pseudolops*, crown and external views of right M_{2-3} , $\times 3$. All redrawn after Ameghino.

The simplest type is seen in *Eudolops*, a single tooth of rather doubtful position in the series. It has two large internal cusps (as do the more advanced cænolestid upper molars) and an external crest, again as in the cænolestids, but with four cusps rather than the normal cænolestid two. *Polydolops* is more complicated, with three inner cusps and on M^2 five, on M^3 three outer cusps, while small secondary cuspules appear in the broad valley between inner and outer crests. In *Pseudolops* the inner crest again has three apices, the outer crests of M^2 and M^3 each having five, while accessory cuspules appear outside the outer crest along the base of the crown, four on M^2 and one on M^3 . The two teeth named *Pliodolops*, probably M^{3-4} , show the greatest specialization. The internal rim is much as before but with four and two apices, respectively, but the outer sides of the two teeth are occupied by numerous conical cuspules, about eleven on M^3 and seven on M^4 , very irregularly arranged. These teeth are "multituberculate" in the literal, etymological sense, but this

is far from an indication of relationship with the Order Multituberculata. "El gran parecido de las muelas superiores de este género con las de *Meniscoessus*" (Ameghino, 1903, p. 145) is non-existent. The two upper molars of *Meniscoessus* have strongly crescentic tubercles arranged in three absolutely parallel, straight longitudinal rows divided by deep V-shaped valleys. One cannot estimate relationships simply by counting cusps.

Turning to the six supposedly multituberculate South American genera referred to families other than the Polydolopidæ, the inadequately known *Anissodolops* is clearly related to *Polydolops*. The even less well known, very minute *Eomannodon* (Fig. 5C) of the Miocene does not resemble the polydolopids at all closely, nor is it like any known multituberculate. Its relationships are altogether uncertain. *Promysops* (Fig. 5A) is apparently related to *Propolymastodon* and the latter has already been discussed. The Miocene *Mannodon* (Fig. 5D) has a modified tuberculo-sectorial lower molar and is of doubtful systematic position, although neither multituberculate nor polydolopid. It may possibly be an abderitine. *Paradoxomys* from the Pliocene is based on a single worn and broken incisor the reference of which to the same family as *Tæniolabis* ("*Polymastodon*") is, in view of its age and imperfections, no better than fantastic.

The only possible conclusion is that none of these genera nor any of the Polydolopidæ are multituberculates and that members of the latter group are as yet quite unknown in South America. This does not necessarily mean that none ever lived there. They may have done so and, in view of current conceptions of later Mesozoic paleogeography, probably did. One would expect to find them only in deposits of Mesozoic or Paleocene age. It is now generally held that the Casa Mayor is post-Paleocene, and if so the only South American pre-Eocene mammal is *Proteodidelphys*.³ Further search of the *Proteodidelphys* Beds of the "areniscas abigarrados" may well reveal the presence of true multituberculates.

Granting that the Polydolopidæ should be included in the Superfamily Cænolestoidea, it may yet appear that the view that the cænolestids were derived from the multituberculates by way of the polydolopids demands consideration. This is so nearly impossible that more than a brief discussion would not be profitable. It strongly opposes the known facts

³Aside from the wholly doubtful "*Archaeoplus*" and a supposed scute and caniniform tooth referred to the Edentata but possibly not even mammalian.

of morphology, evolutionary history, and geological distribution. It supposes typical grasping premolars, common to all truly primitive marsupials and placentals, to be derived from highly specialized shearing teeth. It supposes the appearance of three pairs of incisors, of the canines, and of two pairs of molars quite *de novo*. It supposes tritubercular upper and tuberculo-sectorial lower molars to be derived from the peculiar multituberculate type, suited only for a highly specialized type of jaw motion and musculature and adapted to a restricted diet. It overlooks the fact that skull and skeleton of multituberculates, now almost completely known, show them to be profoundly different from the contemporary early marsupials. It also overlooks the fact that mammals which furnish an excellent morphological ancestry for the later marsupials (and placentals) are present in the middle Jurassic and are then quite as distinct from the Multituberculata as are the Cretaceous and Paleocene Theria. It forgets that the Jurassic, Cretaceous, Paleocene and Eocene multituberculates form a fairly compact series of genera of known evolutionary tendencies, in no way approaching the cænolestoids or any other known marsupials or placentals.

In concluding, the writer wishes to thank Dr. E. Stromer for his kindness in permitting and facilitating observations on the collection in his care at Munich which have been of great assistance in preparing the present paper.

CONCLUSIONS

1. None of the South American genera referred by Ameghino to the Multituberculata have anything whatever to do with that Order.

2. The family Polydolopidæ represents an early and specialized side branch of the group Cænolestoidea, more or less intimately allied to the true Cænolestidæ and like the latter ultimately derived from primitive Cretaceous polyprotodont marsupials similar to or belonging in the family Didelphiidæ in a broad sense.

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59.57,72 (67.5)

NEW STRATIOMYIDÆ AND DIOPSIDÆ FROM THE BELGIAN CONGO (DIPTERA)¹

By C. H. CURRAN

The species herein described were collected by Messrs. Lang and Chapin, members of The American Museum of Natural History expedition to the Belgian Congo. The types are deposited in The American Museum of Natural History.

***Stratiomys rufiventris*, new species**

Head and thorax black; abdomen reddish. Length, 10 to 11.5 mm.

MALE.—Face moderately produced; middle of face, frontal triangle and cheeks brownish red. Vertical triangle with grayish pubescence anteriorly. Hair whitish, black on upper part of occiput and vertex; not abundant on face. Antennæ blackish; style short and obtuse.

Mesonotum and scutellum black-haired, the hair on the upper surface of scutellum short; pleura with white tomentum and erect sparse yellowish hair. Scutellum reddish, with brownish tinge basally, the spines rather long.

Legs reddish, the coxæ, apical half or more of femora, basal half of anterior four tibiæ and the basal fifth of the posterior pair, brownish. Hair yellowish, black on anterior surface of the middle femora and basal half of their tibiæ.

Wings deep brown. Squamæ brown, with brown hair. Knob of halteres greenish. Abdomen shining dark reddish, clothed with very short black hair.

FEMALE.—Head white-haired, the vertex with black hair; median frontal depressions strong, rectangular, the lower, subtriangular depressions weak. Face with appressed white hair.

TYPES.—Holotype, male, Stanleyville, April 5, 1915; allotype, female, Stanleyville, March, 1915.

***Odontomyia impressa*, new species**

Head, thorax and femora black; scutellum and abdomen green, the latter more or less rusty yellowish. Length, 21 mm.

MALE.—Face not greatly produced; eyes contiguous for a very short distance. Hair of head black; golden reddish on the face and anterior half of the cheeks; very short on the vertical triangle. Eye facets enlarged on upper two-thirds. Antennæ black, the third segment brown.

¹Scientific Results of The American Museum Congo Expedition. Entomology, No. 20.

Thorax with whitish hair intermixed on anterior half of the dorsum, the white sheen visible from anterior view, the hair short, longer on the sides and pleura. Scutellum narrowly black basally, with a preapical impression extending between the broadly separated horizontal spines; hair of scutellum very short, rather sparse and reddish in color.

Femora black, black-haired; basal half of anterior and posterior tibiae and the middle pair except the apex, whitish yellow, tibiae apically and the tarsi pale rusty reddish, the anterior tibiae on apical half and a narrow median band on the posterior pair, brownish, the hair short and yellowish, paler on the whitish areas.

Wings with brownish tinge, yellowish brown in front on subapical third, the veins reddish brown, dark brown at base of wing; third vein branched near apex. Squamæ brown, the fringe black. Halteres green.

Abdomen green, clothed with short, subappressed, tawny pile which imparts a more or less rusty yellowish or reddish tinge.

HOLOTYPE.—Male, Stanleyville, April 7, 1915.

Odontomyia seminuda, new species

Black; abdomen reddish; pile very short. Length, 12 to 14 mm.

MALE.—Face moderately produced above, strongly receding below. Eyes contiguous for one-fifth the length of the front; vertical triangle bare. Hair of vertex black; on face, cheeks and occiput pale yellowish, very short on the face; a narrow orbital patch of white hair on upper part of face. Antennæ blackish; style slender, as long as the apical two annuli. Facets enlarged on upper two-thirds of eye.

Thorax coarsely punctured, the hair extremely short, black on the mesonotum, its sides and the pleura with whitish, pubescence-like hair. Scutellar spines mostly reddish, long, widely separated, directed upward at angle of forty-five degrees; hair black.

Legs black or brown; tarsi reddish yellow, the posterior four tibiae reddish apically; pubescence of front tibiae golden yellow. Hair of legs black; yellowish on apical portion of tibiae and on the tarsi.

Wings brownish; the veins brown. Lower squamal lobe whitish and white-haired. Knob of halteres green.

Abdomen rusty reddish, usually somewhat paler on the broad sides, the hair short and black on the dorsum, the sides broadly and the venter with yellowish hair.

FEMALE.—Face strongly produced; front polished on lower half, with a white pilose triangular depression on either side, above with two deep, coarsely punctate depressions separated by the raised median vitta and reaching almost to the vertex, the hair short and yellowish; cheeks more or less reddish on anterior half. Pale hair inclined to extend well on to the dorsum in front of the suture. In other respects similar to the male.

TYPES.—Holotype, male, allotype, female. Paratypes: two males, four females, March, and three females, April, 1915. All from Stanleyville.

***Odontomyia gracilis*, new species**

Head, thorax and legs black; abdomen and tarsi reddish. Length, 14 to 16 mm.

MALE.—Face moderately prominent, receding below; eyes contiguous for one-third the length of the front, with enlarged facets on upper two-thirds. Vertical triangle with very short black hair laterally and at vertex. Occiput with rather short black hair above. Lower half of occiput, the cheeks and face with long brassy yellow hair, the frontal triangle with short yellow hair above. Antennæ reddish brown, the style yellow, tapering.

Mesonotum black-haired; pleura and pectus yellow-haired, the former with black hair intermixed on upper half. Scutellum with the free border deep reddish, spines reddish, curving upwards, the hair black.

Legs with yellowish hair; all the tibiæ more or less distinctly reddish on apical half, the posterior femora obscurely reddish on basal half.

Wings brownish. Squamæ whitish, with brown hair. Knob of halteres pale greenish.

Abdomen reddish, clothed with appressed, short tawny pile.

FEMALE.—Front as wide as face, the lower depressions transverse, the upper depressions not conspicuously punctured, all the depressions bearing short, pale yellowish pile. Thorax with very short, pubescence-like yellowish hair, the mesonotum bearing numerous small tubercles.

TYPES.—Holotype, male, March, 1915; allotype, female, April 27, 1915. Paratypes: male, March, 1915, and two males, April, 1915. All from Stanleyville.

***Odontomyia protrudens*, new species**

Blackish; thorax densely clothed with appressed brownish red pile; scutellum and first abdominal segment pale yellow. Length, 13 to 14 mm.

FEMALE.—Face rather strongly produced, receding below, castaneous, the lower orbits and cheeks yellow; a reddish orbital spot on either side at the vertex. Pile brassy yellow, the lower third of the front practically bare; ocellar swelling with black hair. Antennæ brown, the basal segments blackish, terminal annulus and style yellow, the style tapering.

Mesonotum with coarse, tomentum-like rather golden pile, the pleura yellow pilose. Scutellum with rather sparse appressed yellow hair; apex of spines brown.

Legs reddish yellow; apical third or more of the femora, broad base of anterior and narrower base of middle tibiæ and the posterior tibiæ except a broad band at the basal third, blackish; apices of the anterior four tibiæ and all the tarsi, reddish. Hair yellow, black on upper surface of middle femora and on anterior surface of apical fourth of the posterior pair.

Wings tinged with luteous; brownish on apical third, the base yellowish. Squamæ whitish, with yellow pile. Knob of halteres green.

First abdominal segment yellowish green, the second with a linear yellow spot on either side of posterior border, the sternites with broad yellowish or luteous posterior borders, the third and fourth segments with indications of spots similar to those on the second. Pile appressed, black on the dorsum, yellow on the first segment, base of second and 3rd venter.

TYPES.—Holotype, female, April 5, 1915, and paratype, female, April 7, 1915, Stanleyville.

***Odontomyia deceptor*, new species**

Brownish, the pile tawny; eyes haired. Length, 10 to 14 mm.

MALE.—Face moderately produced, the lower part and cheeks yellow. Eyes contiguous for one-fifth the length of the front; frontal triangle without pile; vertical triangle with longish pile; pile brassy reddish, long, the ocellar tubercle with black hair. Antennæ brownish red, the style short, strongly tapering. Hair of eyes sparse, subsquamose.

Posterior calli and scutellum reddish, the pile thick and moderately long, on the dorsum tawny, on pleura brassy yellow.

Legs brown; basal half of the femora, a broad band before the middle of the tibiæ, the apices of the tibiæ more or less broadly and the tarsi wholly, reddish yellow. Pile of legs yellowish, on the anterior femora posteriorly, the middle pair dorsally and apically and on the black portion of the posterior femora, black.

Wings brownish, the apical fifth much paler, the basal third more or less luteous anteriorly. Squamæ white, with white hair. Halteres with green knob.

Abdomen rather shining, the apices of the second and following segments reddish yellow, the yellow fascia on the second segment very broadly interrupted in the middle. First sternite greenish yellow, the remaining ones with the posterior border yellow. Pile tawny on the dorsum, yellow basally and on the venter.

FEMALE.—Face reddish; front as wide as face, with long tawny pile, the lower fifth bare.

TYPES.—Holotype, male, allotype, female, Stanleyville, March, 1915. Paratypes: eight males, four females, Stanleyville, March and April, 1915.

***Odontomyia (Oplodontha) aureovittata*, new species**

Readily distinguished from *guerini* Macquart and *dispar* Macquart by the blackish scutellum and extensively black legs. Length, 7.5 mm.

MALE.—Head black, the cheeks and palpi yellow, face moderately prominent; eyes touching for a distance equal to half the length of the front; vertical and frontal triangles bare; hair of head whitish with brassy tinge. Antennæ with the first two segments reddish, the third brown; style short and obtuse apically.

Thorax black; mesonotum from posterior view with four pale golden or brassy pilose vittæ, the outer two comprising part of the heavily pilose lateral margins, the mesonotum also with erect, longer brassy pile; pile of pleura becoming whitish below. Spines of scutellum, as well as the immediate apex, yellow.

Femora black, the base reddish, the apex and basal half of the tibiæ yellow; apical half of tibiæ black or brown, the tarsi yellow basally, becoming brown apically. Hair yellowish.

Wings hyaline; third vein not branched. Squamæ and pile whitish. Halteres with greenish knob.

Abdomen with the median third or more black, the black vittæ expanding posteriorly, the sides of the apical segments and apex of the abdomen always reddish or reddish yellow. Venter variable, usually about half blackish. Pile short, appressed, pale yellowish.

FEMALE.—Front and face separated by a subtriangular, oblique depression, the front with a moderately wide transverse depression on either side near the middle,

below the depression quite strongly swollen, the depression with abundant, short pile. Pile of thorax very short, the median vittæ absent; abdomen black, the narrow lateral margins reddish, the apex yellow.

Types.—Holotype, male, allotype female, and one male paratype, Stanleyville, March, 1915.

DIOPSINA, new genus

Related to *Diasemopsis* but at once distinguished from all the genera in the family by the short scutellum which is deeper than long and bears a pair of long black discal bristles. The scutellar spines (if normally present) are broken off, but it is possible that these are replaced by bristles, or if they are present they are very short: there are scars present but it is not possible to determine the armature. The pile or hair is wholly sparse, long and subsquamosa, the hairs being blunt at the tips, the dorsum of the first three abdominal segments bare. The eye-stalks are short, although very much longer than in *Sphyracephala*. There is a pair of intra-alar, and of supra-alar and notopleural bristles. The bristles of the eye-stalks are long and are situated a little beyond the middle of the distance from the ocelli to the tip of the eye, the ocular bristle strong.

Genotype.—*Diopsina ferruginea*, new species.

Diopsina ferruginea, new species

Reddish ferruginous, the face, pleural spines, scutellum and legs rusty yellow. Length, 4 mm.

Male.—Upper half of face prominent, convex, the oral margin with a small tooth on either side; front with four or five longitudinal ridges; hair rather evenly distributed, black on the black apical portion of the eye-stalks; antennæ reddish, the arista subapical, black.

Hair of mesonotum arranged in rows, the mesonotum moderately convex; hypopleural spines long. Scutellum short, its upper surface convex.

All the femora with broad, incomplete, preapical brownish bands, the posterior tibiæ with two broad, brownish bands, one near the base, the other at the apex; tarsi, especially the front pair, darker apically.

Wing brown, the basal fourth and two large spots in the base of the marginal cell, hyaline; seven large whitish spots in the brown field; three forming an inwardly bowed fascia at the apical fifth of the wing, two just beyond the middle of the wing, the anterior one resting on the costa and extending across the submarginal cell, the posterior spot immediately beyond the apex of the second basal cell; the remaining white spots are situated, one close to the apex of the first basal cell and the other behind it, resting on the wing margin. Halteres white.

Abdomen with almost parallel sides on nearly the basal half, thence rather strongly clubbed and convex; apices of all the sternites and a median vitta on the third and fourth, whitish.

Holotype.—Male, Faradje, January, 1913.

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FOUR NEW SNAKES AND A NEW LIZARD FROM SOUTH CHINA¹

CLIFFORD H. POPE

Since recently describing a new lizard and 6 new snakes collected for the Third Asiatic Expedition of The American Museum of Natural History in Fukien Province, China (American Museum Novitates, June 23, 1928), I have found 5 more new forms, 3 of which I describe here as new species, 2 as new subspecies. Four of the 5 were collected for the Third Asiatic Expedition, 3 by myself in Kiangsi and Fukien Provinces, and 1 by Walter Granger in Yunnan Province. The fifth, also from Yunnan, was secured for the Museum by Mr. John Graham.

The American Museum's earlier reptile collections from China were reported by Karl P. Schmidt in 1927. A report on all the more recently collected Chinese reptiles, now in manuscript form, will appear shortly. It will contain an account of all the Museum's Chinese reptiles not already treated by Schmidt.

Kuatun, from where many species have been described, is a village in the mountains of Ch'ungan Hsien, the type locality for two of the forms described herein.

SAURIA

Gekko japonicus hokouensis, new subspecies

TYPE.—A. M. N. H. No. 35090; ♂; Hok'ou, northeast Kiangsi Province, China; June 28–July 12, 1926; Clifford H. Pope.

DIAGNOSIS.—Differs from typical *japonicus* chiefly in having a large, undivided tubercular scale on each side of the base of the tail.

DESCRIPTION OF TYPE.—Head moderately large; snout longer than distance between eye and ear-opening, about twice diameter of eye; ear-opening suboval, oblique. Digits moderately expanded with slight but distinct rudiments of web; the single pair of chin-shields longer than broad, bordered in front and on the sides by mental, 2 lower labials, and 2 shields each half as large as the chin-shields; bordered behind by 4 small, subequal shields. The back and limbs are covered with small, granular scales intermixed with numerous, small, subconical tubercles which are

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 82.

larger and more numerous along the upper sides than down the center of the back; preanal pores 6; single tubercular scale on each side of base of tail three-fourths as long as diameter of eye. Length from snout to vent 56 mm., from vent to end of tail (which has a bit of end missing) 65 mm.

The color is grayish brown with 5 very indistinct, slightly darker cross-bands on the back, and 9 rather distinct ones across the tail.

There are 14 paratypes from the type locality (Nos. 35087-100), and 1 from Ch'ungan Hsien (No. 33491).

SERPENTES

Colubridæ

***Zaocys dhumnades montanus*, new subspecies**

TYPE.—A. M. N. H. No. 34334; ♀; Ch'ungan Hsien, northwest Fukien Province, China. April-September, 1928; Clifford H. Pope.

DIAGNOSIS.—Distinguished from the typical form by a higher ventral and caudal count. The ventrum is much darker than in typical *dhumnades*.

DESCRIPTION OF TYPE.—Rostral broader than deep, visible from above; internasals shorter than the prefrontals, which are not as long as their distance from end of snout; frontal almost as long as its distance from tip of snout, just as long as parietals which are nearly as broad as long. Loreal longer than deep; a large preocular with a small one below; 2 postoculars; 2 anterior, and 2 posterior temporals. Eight upper labials, fourth and fifth entering eye; 10 lower labials, first 5 in contact with anterior chin-shields. Scales reduced from maximum of 16 to minimum of 14 at a point opposite 103d ventral; smooth on neck, 2 rows sharply keeled at midbody and before vent. Ventrals 195; anal divided; subcaudals 123+. Total length 1475 mm.+, about 0.28 occupied by tail.

The posterior half of the body above and below is slaty black. The milky color of the throat and ventral surface of the head merges with the darkening belly color. Anteriorly, on either side of the 2 mid-dorsal rows of scales, is a black stripe, itself covering 2 scale rows. Below this stripe the scales have black borders and bluish centers. The lateral tips of the ventrals are edged with black. Some distance posterior to the head the scales of the third row lose their light centers forming a narrow, black stripe that is soon lost in the uniform black of the posterior section of the snake. The top and upper sides of the head are slate-colored.

There are 11 paratypes from the type locality (Nos. 33627-632 and 34329-333), and 1 from Yenping (No. 33242). I also place A. M. N. H. Nos. 17445, 17452 and 24621 from Changsha, Hunan Province, here. The Changsha specimens were collected by Mr. J. W. Williams.

***Dinodon flavozonatum*, new species**

TYPE.—A. M. N. H. No. 34371; ♂: Ch'ungan Hsien, northwest Fukien Province, China; April-September, 1926; Clifford H. Pope.

DIAGNOSIS.—Closely allied to *rufozonatum* from which it differs chiefly in having yellow instead of red cross-bands.

DESCRIPTION OF TYPE.—Rostral broader than deep, plainly visible from above; internasals much shorter than prefrontals, which are a little shorter than frontal; frontal slightly longer than broad, just as long as its distance from rostral; length of

parietals equals their distance from end of snout. Loreal longer than deep, not entering eye. One pre- and 2 postoculars; temporals 2-3. Eight upper labials, third, fourth, and fifth entering eye; 10 lower labials, first 5 in contact with anterior chin-shields which are as long as, and slightly broader than, posterior. Scales in 17 rows to a point opposite seventy-first ventral plate from anus where fourth row drops out; in 15 rows posterior to this; 7 rows feebly keeled at midbody; all scales smooth on neck. Ventrals 218; anal entire; subcaudals 87; apical pits double. Total length 965 mm., 0.20 of which is tail length.

The uniformly black ground-color of the dorsum is crossed anterior to the vent at regular intervals by 68 narrow, yellow bands each about half as wide as a scale is long. Every band divides on the fifth scale-row, each half joining a branch from the adjacent ones before descending to the ventrals. This lateral pattern is not very distinct and encroaches slightly on the white ventrals. Most of the 21 tail-bands are as wide as a scale is long, and none of them splits laterally. The subcaudals are black, weakly light mottled. The top of the head is black save for a yellow stripe from behind the eye to the angle of the mouth; narrow yellow borders on some of the plates, and a nuchal, V-shaped, yellow band with its apex on the posterior tips of the parietals. The first 2 and the eighth or last upper labials are black, the rest black and yellow. The throat is white, except for black trimmings on the anterior lower labials. The yellow of the dorsum fades with preservation into a dirty white.

The 19 paratypes (Nos. 33641-647, 34370 and 34372-382) come from the type locality.

***Bungarus wanghaotingi*,¹ new species**

TYPE.—A. M. N. H. No. 35230; ♀; Yuan Kiang, southwestern Yunnan Province, China; November, 1926; Walter Granger.

DIAGNOSIS.—Allied to *candidus* from which it differs chiefly in having a higher ventral count. The dorsal bands are much more numerous than in *multicinctus*.

DESCRIPTION OF TYPE.—Rostral much broader than high, touching 6 scales, its suture with first upper labial about one-fifth as long as that with nasal; internasals two-thirds as long as prefrontals, which in turn are three-fourths as long as frontal; frontal slightly shorter than its distance from tip of snout, just as wide as parietals, which are as long as their distance from rostral; a single scale between nasal and eye. Seven upper labials, third and fourth entering orbit; 2 postoculars, upper twice as large as lower; one temporal; 7 lower labials, first 4 in contact with anterior chin-shields, fourth much the largest; posterior pair of chin-shields shorter than anterior. Scales in 15 rows throughout. Ventrals 228; subcaudals 53. Total length 484 mm., 0.13 occupied by tail; anal and subcaudals entire.

The black ground-color is crossed by 23 white bands on the body, 11 on the tail. These white bands cover 3 mid-dorsal scales on the neck where they are 16 scale-lengths apart, while posteriorly they are only half as wide and 4 scale-lengths apart. All of them expand before joining the uniform white of the belly, and near the center of each, at its juncture with the belly, there is a small, dark spot. Many of the white bands have a few black-centered scales. The black of the ground-color barely encroaches on the tips of the ventrals. Above the upper labials, the top and sides of the

¹Named for Mr. Wang Hao-t'ing, of Peking, who for two years faithfully painted reptiles and amphibians from life for the Third Asiatic Expedition.

head are black. On either side of the neck, just back of the parietals, the scales are dimly white-tipped.

The single paratype (No. 35229) comes from the type locality.

Amblycephalus niger, new species

TYPE.—A. M. N. H. No. 22703; ♀; Yunnanfu, Yunnan Province, China; John Graham.

DIAGNOSIS.—An *Amblycephalus* with a black tail and a large amount of black on the dorsum. The loreal is excluded from the eye, and at midbody 7 rows of scales are keeled.

DESCRIPTION OF TYPE.—Rostral as broad as deep; internasals in contact with loreal and half as large as prefrontals which enter the orbit; frontal, without its posterior projection, about as broad as deep, much shorter than, but about as wide as parietals which are as long as their distance from tip of snout. Loreal widely separated from eye by a distinct preocular and enlarged end of a subocular; a long, narrow scale separates eye from upper labials; anterior temporals 2, separated from eye by narrow scale below, wider one above; posterior temporals 3-3. Upper labials 7-7; lower, 7-7, first pair narrowly in contact behind mental; first 4 in contact with anterior chin-shields which are longer than broad; second pair slightly broader than long, third much broader than long; diameter of eye equals half interorbital space. Scales in 17 rows, vertebral row not enlarged. Ventrals 165; subcaudals 64; anal entire. Total length 502 mm., 0.22 occupied by tail.

The solid black of the top of the head extends down about to the loreal and lower anterior temporal where it begins to break into profuse spots which in turn become less profuse until, on the upper labials, they are sparse. On the lower labials and chin-shields the spots are reduced to a little scattered speckling. The neck and back are black but the black is broken on the sides by very irregular, light areas extending upward from the light ventrals, and suggesting the remnants of bands that have all but disappeared. Toward the tail these light areas are much more marked than they are anteriorly. The belly is light except for very irregular, sparse mottling mostly in the form of spots or narrow intrusions of the black of the dorsum. The tail is uniformly black with a little light mottling on the first 10 to 12 subcaudals.

The type is unique and was reported by Schmidt in 1927 as *chinensis*.

A. niger differs markedly in color from all the other Chinese species. In addition it is distinguished from all but *yunnanensis* and *stanleyi* by its keeled scales. In *yunnanensis* the loreal reaches the eye and the vertebral row is enlarged, so from this species *niger* is amply distinct. The low caudal count in *stanleyi* separates it not only from *niger* but the rest of the Chinese species as well.

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A RARE SOLE FROM THE BAHAMAS

BY J. T. NICHOLS AND VAN CAMPEN HEILNER

The American Museum of Natural History is in receipt of a banded dextral sole collected in the Bahamas (Heilner). It was picked up on the shores of North Bimini Bay in March 1928, having either floated there dead or become stranded on a receding tide. It is at least close and presumably referable to *Gymnachirus nudus* Kaup, 1858, from Bahia, Brazil, a species that the writers have not seen, and which does not appear to be well known or anywhere common. In any event the specimen to hand, with a total length of 6 and standard of $4\frac{3}{4}$ inches, represents a fish as rare in North American waters as it is beautiful, and it will be advantageous to publish a figure herewith, drawn by Mrs. Louise Nash, with a few words of description as follows:

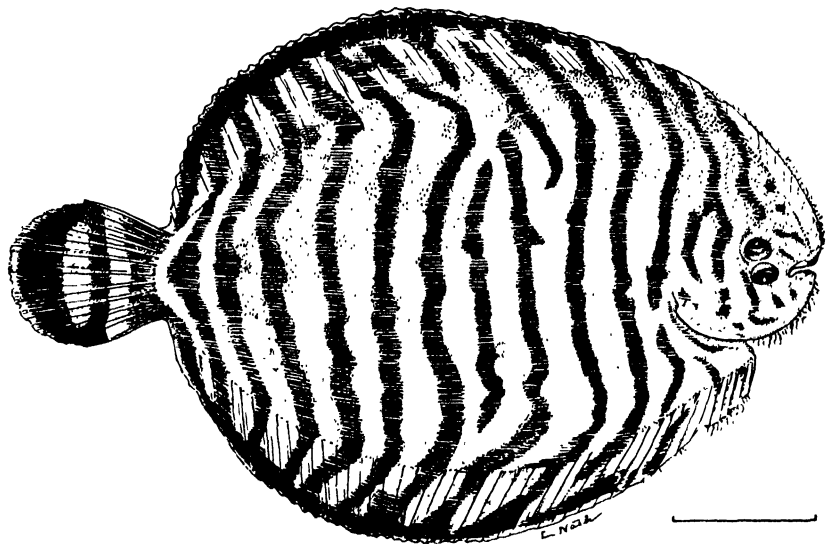


Fig. 1. *Gymnachirus nudus* Kaup, from the Bahamas.

Depth (without fins) in length (to base of caudal), 1.7; head, 4. Dorsal rays, 62; anal, 43; ventral, 5. The lateral line (plainly visible on blind side) runs almost straight. There are indications of very small, rudimentary scales on the colored side (though *Gymnachirus* is supposed to be quite scale-less). Pectoral fins are absent.

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NEW SPECIES OF *OMMATIUS* FROM AMERICA, WITH KEY: (ASILIDÆ, DIPTERA)

BY C. H. CURRAN

In the 'Kertész Catalogue' twelve species of *Ommatius* Wiedemann and one *Emphysomera* Schiner are listed from America, while two have been described by Banks. *O. tibialis* Say has been placed as a synonym of *marginellus* Fabricius, but is distinct. We therefore have fifteen described species belonging to the genus *Ommatius*, since there is no character of value separating *Emphysomera*. The collection of The American Museum of Natural History contains representatives of seven species not yet described and descriptions of these are now presented. A key to the species available is given, but it is not possible to include all the described species since several of the characters used in their separation are not mentioned in the original descriptions.

TABLE OF SPECIES

- | | |
|---|-------------------------------|
| 1. Posterior tibiae yellowish or reddish on basal fourth or more | 2. |
| Posterior tibiae wholly brown..... | 15. |
| 2. Without pteropleural bristle..... | 3. |
| With a pteropleural bristle..... | 14. |
| 3. With a pair of marginal scutellars..... | 4. |
| Without marginal scutellars..... | 9. |
| 4. Middle tarsi wholly black or brown..... | 5. |
| Middle tarsi with the first segment mostly yellow..... | 7. |
| 5. Middle tibiae black on the lower surface..... | <i>orenoquensis</i> Bigot? |
| Middle tibiae mostly yellowish..... | 6. |
| 6. Second posterior cell narrowed near its apex..... | <i>amula</i> , n. sp. |
| Second posterior cell not at all narrowed..... | <i>norma</i> , n. sp. |
| 7. Middle tarsi almost wholly reddish..... | <i>pretiosus</i> Banks. |
| Apical four segments of middle tarsi brown or black..... | 8. |
| 8. Posterior femora with setigerous tubercles only on the anteroventral surface
(in female; male without coarse bristles)..... | <i>neotropicus</i> , n. sp. |
| Posterior femora with setigerous tubercles on antero- and posteroventral
surfaces..... | <i>marginellus</i> Fabricius. |
| 9. Middle femora with one or more coarse black bristles below..... | 10. |
| Middle femora with only fine hair-like bristles below..... | 12. |
| 10. Mesonotum with longish white hair posteriorly in addition to the dorsocentral
hairs or bristles..... | <i>tibialis</i> Say. |
| Mesonotum with scarcely a trace of hair posteriorly..... | 11. |

11. Anterior four femora mostly black. *willistoni*, n. sp.
Anterior four femora reddish. *spatulatus*, n. sp.
12. Supra-alar bristle black. 13.
Supra-alar bristle white (Arizona). *maculatus* Banks.
13. Genitalia of both sexes reddish. *ruficauda*, n. sp.
Genitalia of both sexes shining black. *pulchra* Engel.
14. Posterior tarsi wholly brown or black. *exilis*, n. sp.
Tarsi wholly reddish yellow. *pilosus* Bigot.
15. Legs wholly black (Mexico). *parvus* Bigot.
Legs mostly yellowish (S. A.). *apicalis* Schiner.

Ommatius norma, new species

Blackish, the legs largely reddish. Length, 8 to 12 mm.

FEMALE.—Face and upper part of occiput brassy yellowish, cheeks and lower part of occiput grayish, the front brownish. Front wider than face, slightly widening above. Hair of head with yellowish tinge, the frontal bristles, occipital cilia and the bristles of the mystax, black, the hair of the mystax extending far on to the face in two or four rows. Antennæ black, the third segment two and one-half times as long as wide.

Mesonotum brownish pollinose, the lateral and posterior borders brownish gray; pleura and scutellum grayish pollinose, the mesopleura and broad base of scutellum with brown tinge. Hair and bristles of the mesonotum and the scutellar bristles, black; hair of pleura and scutellum fine, whitish. Pteropleura with fine, scattered hairs.

Coxæ blackish, gray pollinose. Femora reddish, the posterior pair blackish on apical half or more, the middle pair blackish on apical half except below, the anterior pair blackish on upper surface; tibiae yellow, the apical fourth to third of the anterior four and the apical half of the posterior pair brown, the tarsi wholly brown. Middle femora with long yellowish hair below, on the basal half of the anteroventral surface with one or two rather fine black bristles, the anterior surface with two or three black bristles. Posterior femora with five or six setigerous tubercles on the anteroventral surface and one near the apex on the posteroventral surface, the bristles black.

Wings cinereous hyaline, grayish on apical fourth and the broad posterior margin of the apical third.

Abdomen subshining, thinly brownish pollinose, the apices of the segments and the venter, grayish. Hair very short, yellowish, blackish on the disc of the apical two or three segments.

MALE.—Femora more extensively brown, all more or less strongly swollen, the middle pair with a row of black bristly hairs on the anteroventral surface.

TYPES.—Holotype, female, British Guiana, February 12, 1913, in American Museum of Natural History. Allotype, male, Bartica, May 29, 1901. Paratypes: fourteen females, Kartabo, 1921, July 19, 1922, Aug. 17, 1922, May 17, 19, 20, 27 and June 9, 1924; Bartica, May 18, 19, 20 and 22, 1901; and female, Bello Horizonte, Minas Geraes, Brazil, Nov. 1-6, 1919. Paratypes in the Phil. Acad. Nat. Sciences, N. Y. Zool. Soc., and Cornell University.

***Ommatius neotropicus*, new species**

Blackish, the legs reddish yellow; costa not dilated in male. Length, 8 to 10 mm.

MALE.—Head grayish pollinose, face with yellow tinge, the front brown. Hair of head whitish, the occipital cilia and about six bristles in the mystax black. Antennae black, the third segment subcordate, about one and one-half times as long as wide.

Mesonotum black, thinly brownish pollinose, the lateral and posterior borders with grayish pollen. Pleura and scutellum gray pollinose, the mesopleura and base of scutellum with brown tinge. Hair whitish; bristles black, scutellum with pair of marginal bristles and usually several whitish hairs on the disc; hypopleural bristle absent.

Coxae brownish, gray pollinose; apex of each femur broadly brown above, apical third of posterior tibiae, usually the apex of the middle pair and the tarsi, brown, the anterior four tarsi with the basal segment chiefly yellow. Femora somewhat swollen, the middle pair with yellow hair below and two black bristles on the apical third of the anterior surface; posterior femora with yellow hair below, without bristles.

Wings cinereous hyaline, the apical third grayish. Squamae whitish, halteres yellow.

Abdomen black, somewhat shining, thinly brownish pollinose above, the incisures more or less distinctly, the lateral margins and the venter, gray pollinose. Hair yellowish, short, appressed, on the dorsum of the apical two or three segments and the genitalia, black, yellowish on the red portions of the genitalia. Genitalia black on basal half, the apical half reddish.

FEMALE.—Middle femora with two black, anteroventral bristles; posterior femora with a row of five anteroventral bristles arising from low tubercles and with two or three weak, black bristles on the posteroventral surface. Genitalia black.

Types.—Holotype, male, British Guiana, March 11, 1913. Allotype, female, Kiaeteur, British Guiana, July 30, 1911, (F. E. Lutz), in the American Museum of Natural History. Paratypes: three females, Kiaeteur, Aug. 8, 10, 11, 1911; two females, Kartobo, Aug. 6, 1922 and April 23, 1924; female, Waratuk, Feb. 16, 1921; female, Bartica, May 15, 1901; and female, Bello Horizonte, Minas Geraes, Brazil, Nov. 1–6, 1919, (R. G. Harris). Paratypes in Cornell University, New York Zoölogical Society and Philadelphia Academy of Natural Sciences.

***Ommatius willistoni*, new species**

Black, the legs largely yellowish; abdomen not coarctate. Length, 13 mm.

FEMALE.—Head whitish pollinose, the front and occiput more grayish. Hair and bristles whitish, about six black occipital cilia on either side. Antennae black, the third segment subcordate, not one and one-half times as long as wide.

Mesonotum moderately brown pollinose, the sides, posterior border and pleura grayish. No scutellar or dorsocentral bristles. Pleural hair whitish.

Coxae and femora black, the former gray pollinose, the tips of all the femora and the under surface and base of the posterior pair, reddish; tibiae yellowish with the apices broadly brown; tarsi brown with the basal segment brownish red. Middle femora with two anteroventral bristles situated before the middle, and three anterior bristles, two of them low down on the apical half, the third near the base. Posterior femora with five black bristles arising from tubercles on the apical two-thirds of the

anteroventral surface and several short, weak bristles on the posteroventral surface. Hair whitish.

Wings hyaline, the stigma brown. Squamæ yellow, with white fringe. Halteres yellow with brownish-red knob.

Abdomen black, brownish pollinose above, the lateral margins, posterior segmental fasciæ and the venter, grayish pollinose. Hair yellowish, blackish on the disc of the segments. Genitalia reddish.

HOLOTYPE.—Female, Tepetlapa, Guerrero, Mexico, 3000 ft., Oct., (H. H. Smith), in American Museum of Natural History.

***Ommatius spatulatus*, new species**

Blackish; abdomen spatulate, less strongly so in female; costa of male dilated. Length, 12.5 mm.

MALE.—Head grayish yellow pollinose, the front more brownish; hair white; occipital cilia, ocellar bristles and two or four of the bristles in the upper part of the mystax, black. Antennæ black, the third segment slightly more than twice as long as wide.

Mesonotum black, brown pollinose, a pair of slender, dorsocentral vittæ, brownish red, the lateral and posterior borders, yellowish, the pleura and scutellum grayish pollinose, the mesopleura with brownish tinge above. Scutellar and dorsocentral bristles absent; no pteropleural bristle.

Legs reddish, the femora brownish red except below and basally, the posterior tibiæ brownish red on apical third, the middle pair on apical fifth or less; tarsi brownish red, the basal segment and the tibiae, at least above, yellowish. Middle femora with one anteroventral and three or four posteroventral bristles on basal half; posterior femora with four or five anteroventral and posteroventral whitish bristles arising from low tubercles. Hair pale yellowish.

Wings with an extensive yellowish brown cloud behind the stigma, the apex grayish, the basal two-fifths hyaline. Squamæ with yellowish border. Halteres yellow.

Abdomen black, the apical segments shining, moderately brown pollinose, the lateral margin, broad apices of the first to fourth segments, and the venter, grayish pollinose, the brown pollen restricted to form oval spots on the second and third segments. Pile yellowish, black on the brown pollinose areas. Genitalia reddish brown.

FEMALE.—Differs only sexually; valves of ovipositor reddish.

YPES.—Holotype, male, August; allotype, female and paratype male, Rio de Janeiro, Brazil, Nov., (Williston Coll.), in American Museum of Natural History.

***Ommatius amula*, new species**

Blackish, the abdomen slightly coarctate; tibiæ yellow. Length, 12 mm.

FEMALE.—Head grayish yellow pollinose, the front more golden; hair of the front, the occipital cilia and four pairs of bristles in the mystax, black. Antennæ black, the third segment twice as long as wide.

Mesonotum brown pollinose, with a pair of slender, yellowish vittæ, the lateral margins and posterior border, yellowish; pleura grayish pollinose with yellow tinge above. Mesonotal hair black; pleura and scutellum white-haired, the scutellum with a pair of black marginal bristles; three pairs of dorsocentrals.

Legs black; anterior and middle femora below and the narrow base of all the femora, castaneous, the anterior pair with a yellowish spot apically on the under surface; tibiae yellow, the apical third of the posterior pair and the apical fifth of the anterior four, brown; tarsi wholly brownish. Hair of legs yellowish. Middle femora with two black, anteroventral bristles, the posterior pair with seven anteroventral and five posteroventral bristles arising from low tubercles, the bristles on the apical half black, the others whitish.

Wings hyaline, the apical fourth grayish; stigma brown. Squamæ and halteres yellowish.

Abdomen brownish pollinose, the broad lateral margins, posterior fasciæ on the basal six segments and the venter, with gray pollen. Eighth segment wholly, the seventh on the sides and apex, shining. Hair yellowish, black on the disc of the abdomen. Genital valves reddish.

HOLOTYPE.—Female, Amula, Guerrero, Mexico, September, 6000 ft., (H. H. Smith), in American Museum of Natural History.

Ommatius exilis, new species

Blackish; legs reddish yellow; bristles of abdominal segments reddish; costa not dilated. Length, 11 to 14 mm.

MALE.—Face and front golden pollinose, the occiput gray; pile whitish; four bristles in the mystax above, the ocellar bristles and occipital cilia black. Antennæ brown, the third segment subcordate, a little more than one and one-half times as long as wide.

Thorax black, gray pollinose, the mesonotum mostly dull black with thin brownish pollen. The blackish color forms three narrowly separated vittæ, abbreviated behind, the outer vittæ abbreviated in front, the middle one with a small, elongate, posteriorly tapering gray spot in the middle anteriorly. Hair and bristles of the dorsum and the scutellar bristles, black, elsewhere whitish. Pteropleural bristle white.

Coxæ black, gray pollinose; anterior four femora with a broad brown vitta on upper part of anterior surface, the posterior pair brown on apical two-fifths; middle tibiae on apical fifth, the posterior pair on the apical third and the tarsi, brown, the basal segment of the anterior four tarsi, yellowish. Middle femora with two weak, anteroventral bristles. Posterior femora with a row of seven or eight short bristles arising from tubercles on anteroventral surface, the basal two or three white, on the posteroventral edge with three small bristles apically and two basally.

Wings grayish on apical half. Squamæ and halteres yellowish.

Abdomen brownish pollinose, the sides broadly and the venter gray. Pile pale yellowish, black on the disc of the apical two or three segments. Genitalia brownish red.

TYPES.—Holotype, male, and paratype, male. Chapada, Brazil, (Williston Coll.), in American Museum of Natural History.

Ommatius ruficauda, new species

Blackish brown; costa simple; abdomen slightly spatulate. Length, 10 to 11 mm.

MALE.—Head yellowish pollinose; pile of face yellow, of the occiput white; occipital bristles and orbital cilia black. Antennæ blackish, the third segment missing.

Mesonotum grayish pollinose, with three very broad black vittæ which are very narrowly separated from each other, the outer two as broad as long, interrupted at the suture and abbreviated in front and behind, the middle one abbreviated posteriorly. Dorsocentrals yellow, scutellar and pteropleural bristles absent; mesonotum posteriorly and the pleura, yellowish-white haired.

Coxæ blackish, gray pollinose; legs reddish yellow, anterior four femora with broad brownish vittæ on upper part of anterior surface, the posterior pair with the apical fourth brownish except below; apical fifth of posterior tibiæ and the apical three segments of all the tarsi, brownish, the first and second segments with the tips brown. Middle femora with yellow bristly hairs below, posterior femora with a row of eight to ten black anteroventral bristles arising from low tubercles, and three or four near apex and one at base on the posteroventral surface.

Wings tinged with brown. Squamæ and halteres yellowish.

Apices of abdominal segments, the broad lateral margins and the venter, gray pollinose. Pile yellowish tinged, black on disc of apical three segments. Genitalia reddish.

FEMALE.—Mystax with four black bristles above. Middle femora with two yellow, anteroventral bristles; posterior femora with a row of eight black bristles arising from tubercles on anteroventral surface.

Types.—Holotype, male, allotype, female, Chapada, Brazil, (Williston Collection), in American Museum of Natural History.

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PLEISTOCENE MAMMALS FROM A CAVE IN CITRUS COUNTY, FLORIDA

BY GEORGE GAYLORD SIMPSON

The mammals to be described in this paper were found in a cave in the Ocala Limestone (Eocene) on the property of Mr. D. J. Allen, one mile northwest of Lecanto, Citrus County, Florida. Murray Davis and some boy companions entered the cave several years ago and found a machærodont canine now in the collection of the Florida State Geological Survey. Through Mr. Herman Gunter, Mr. J. E. King, and Mr. D. J. Allen, Mr. Walter W. Holmes made arrangements for a thorough search of this locality. This work was done under the direction of Mr. Holmes in February and March, 1928, and the resulting collection deposited in the American Museum.

The field name, Saber-tooth Cave, may continue to distinguish this from the several other caves in the immediate vicinity. Entrance to it is through a broad sink terminating in two vertical shafts. Immediately under these the floor of the cave was from 25 to 40 feet below the shaft mouths and there apparently has never been an entrance practicable for large living mammals. On the floor below the sink and in pockets elsewhere was a deposit of red earth or clay in which were found numerous remains of Pleistocene animals, apparently representing a distinctive unit fauna. There also occurred in the cave a younger bed of sand and humus containing no extinct mammals but with numerous remains of the recent white-tailed deer of the region. All of the forms listed below came from the true Pleistocene cave earth.

The figures in this paper were drawn by Louise Waller and John Germann.

FAUNAL LIST

MAMMALIA

Marsupialia

Didelphiidæ

Didelphis virginiana. Lower jaws of about 12 individuals, upper jaws of two, a few limb bones.

Insectivora

Talpidæ

Cf. *Scalopus* sp. One lower jaw without teeth.

Rodentia

Leporidae

Sylvilagus floridanus. 6 lower jaws, skeletal parts.

Sylvilagus palustris. 6 lower jaws, skeletal parts.

Geomyidæ

Geomys floridanus. 4 lower jaws, 2 partial skulls.

Thomomys orientalis, new species. 1 partial skull.

Cricetidae

Sigmodon hispidus. About 40 lower jaws, 4 partial skulls.

Oryzomys palustris. 5 lower jaws.

Neofiber alleni. 21 lower jaws, one partial skull.

Synaptomys australis, new species. One lower jaw.

Hydrochæridæ

Hydrochærus holmesii, new species. 3 associated teeth.

Carnivora

Canidæ

Canis (*Ænocyon*) *ayersi*. 1 lower jaw, 1 upper jaw.

Canis cf. *ayersi*. Lower premolar, upper carnassial, limb bones.

Cf. *Urocyon* sp. Atlas.

Felidæ

Lynx rufus. 1 lower jaw, 1 upper jaw.

Smilodon sp. 1 upper canine, 2 distal ends of humeri.

Mustelidæ

Mephitis elongata. 1 lower jaw.

Xenarthra

Megalonychidæ

Megalonyx cf. *wheatleyi*. 4 teeth, foot bones.

Chlamytheriidæ

Chlamytherium septentrionale. 1 tooth, scutes, limb and foot bones.

Dasypodidæ

Tatu, undescribed species. Scutes etc.

Perissodactyla

Equidæ

Equus cf. *leidyi*. 2 incisors, 3 upper cheek teeth, 2 lower cheek teeth, bones.

Tapiridæ

Tapirus cf. *haysii*. 3 teeth.

Artiodactyla

Cervidæ

Odocoileus osceola. 2 lower jaws in cave earth, numerous remains in subrecent muck and sand.

Blastocerus extraneus, new species. 1 lower jaw.

Camelidæ

Camelid, genus and species undetermined. 2 lower incisors, skeletal fragments.

Tagassuidæ*Mylohyus* cf. *browni*. 2 lower jaws, 3 canines.**Proboscidea****Mastodontidæ***Mastodon americanus*. 1 tooth.**AVES**

(Identifications by Dr. A. Wetmore, who is elsewhere publishing more detailed notes on these remains.)

*Nyroca affinis**Caragyps urubu**Cathartes aura**Halixetus leucocephalus**Falco sparverius**Colinus virginianus**Tyto alba**Strix varia**Otus asio**Meleagris gallopavo***REPTILIA**

Sparse crocodilian, chelonian, and ophidian remains, not studied in detail.

AMPHIBIA

A very few unidentified anuran bones.

FAUNAL ANALYSIS

In the following distributional and ecologic analyses the mammals alone are considered. Doubtful forms are mostly omitted.

DISTRIBUTION**A. Genera and species recently living in this area or immediately contiguous regions:**

Genera	Species
<i>Didelphis</i>	<i>D. virginiana</i>
<i>Sylvilagus</i>	<i>S. floridanus</i>
	<i>S. palustris</i>
<i>Geomys</i>	<i>G. floridanus</i>
<i>Sigmodon</i>	<i>S. hispidus</i>
<i>Oryzomys</i>	<i>O. palustris</i>
<i>Neofiber</i>	<i>N. alleni</i>
<i>Lynx</i>	<i>L. rufus</i>
<i>Mephitis</i>	<i>M. elongata</i>
<i>Odocoileus</i>	<i>O. osceola</i>

B. Genera still living but not in this region:

Thomomys. Now exclusively western, not ranging closer than about 900 miles away.

Synaptomys. Now northern, not ranging closer than about 400 miles away and only in the colder parts of its most southern range.

Hydrochærus. Now South American.

Tatu. Now southwestern, ranging into Texas and adjoining states.

Equus. Not now indigenous in the Western Hemisphere.

Tapirus. Now South American.

Blastocerus. Now South American.

C. Genera and species extinct before historic times:

Genera	Species
	<i>Thomomys orientalis</i>
	<i>Synaptomys australis</i>
	<i>Hydrochærus holmesi</i>
(<i>Ænocyon</i>)	<i>Canis (Ænocyon) ayersi</i>
<i>Smilodon</i>	
	<i>Equus</i> cf. <i>leidyi</i>
	<i>Tapirus</i> cf. <i>haysii</i>
	<i>Blastocerus extraneus</i>
Camelid	
<i>Mylohyus</i>	
<i>Mastodon</i>	
<i>Megalonyx</i>	
<i>Chlamytherium</i>	

Tatu, sp. ined.

Of the 24 species regarding the extinction or survival of which reasonable assurance is possible, 14, or 58%, are certainly extinct. The exact figure is of slight importance as the number of species is not large and many of the larger extinct animals known to have been contemporaneous with faunas of this type in Florida are absent. It is noteworthy that those genera which have survived in this region are represented in this Pleistocene fauna by the recent species.

From a geographic point of view the outstanding new facts are the occurrence of *Synaptomys*, *Thomomys*, and probably *Blastocerus* so far outside their present areas. The rodents suggest that when the Pleistocene microfauna is better known the smaller mammals, as well as the larger, will be found to have enjoyed a much wider range at that time than at present.

ECOLOGY

Mainly wet lowlands, swamps, streams, etc.:

Sylvilagus palustris
Sigmodon hispidus
Oryzomys palustris
Neofiber alleni
Hydrochærus holmesi

Mainly wooded lowlands:

Didelphis virginiana
Sylvilagus floridanus
Geomys floridanus
Lynx rufus
Megalonyx cf. wheatleyi
Mephitis elongata
Tapirus cf. haysii
Odocoileus osceola
Blastocerus eximius
Mastodon americanus

Mainly open lowlands or meadows:

Canis ayersi
Equus cf. leidyi
Camelid

Far the most abundant forms numerically are the small water-loving rodents. Of the other mammals almost all usually live in wooded or marshy lowlands. Horses and camels are rare, while *Myiodon*, *Bison*, *Archidiskodon*, *Glyptodon* and other animals more typical of plains faunas are absent in the collection, although abundant elsewhere in the Florida Pleistocene. *Chlamytherium* and *Tatu* are present (possibly parts of only one of each) and may possibly have been plains forms. The general impression is that the fauna is of rather limited ecologic scope and indicates a wet lowland, with swamps, drier wooded areas, and a few open glades.

This is not a cave fauna from an ecologic point of view. The cave itself was unsuited for occupation by animals of any considerable size and none of the included mammals suggests spelean habits. The cave no doubt served as a trap and also as a sink catching the debris of floods. A few of the bones have been gnawed, but the rodents present are not particularly adapted for cave life and the gnawing may have occurred outside, before the bones were deposited.

There is no suggestion that the climate differed materially from that of the same region now. Many of the mammals indicate warm and moist atmospheric conditions. No boreal elements are present—*Synaptomys* is now boreal, but its associations seem to show that this was not the case with this distinctive fossil species.

CORRELATION

From their preservation and from the absence of extinct species, the bones in the gray sand and muck are probably old historically but of Recent age geologically. The bones in the red cave earth

are strongly mineralized, with the rather chalky preservation characteristic of specimens from limestone caves. From the conditions of occurrence and from the faunal associations, these seem to represent a single phase of geologic time. Despite the limited scope and extent of the fauna, approximate equivalence with the much richer Pleistocene fauna of the Seminole area, Pinellas County, and hence with Stratum 2 of the East Coast, is probable. With the exception of *Thomomys orientalis*, *Hydrochærus holmesi*, *Blastocerus extraneus*, and possibly also *Mylohyus* cf. *browni*, all of the cave species also occur at Seminole. Aside from the latter doubtful case, these exceptions are rare forms and their apparent absence at Seminole is not necessarily significant. The faunal type is the same at both localities, with horse, camel, and tapir associated with species indistinguishable from those still living in the same area. The species of *Tatu*, although it is preferred not to name it on this cave material, is precisely identifiable and is the same as at Seminole.

Discussion of the broader and much more difficult question as to the real age of this deposit, of that of the Seminole Field, and of Stratum 2 at Vero and Melbourne is deferred until the description of the Seminole fauna, now in press.

DESCRIPTIONS

Thomomys orientalis, new species

TYPE.—A. M. No. 23441. Front part of skull with incisors and first two cheek teeth on each side. Collected by Carl Sorensen.

HORIZON AND LOCALITY.—Pleistocene, Saber-tooth Cave, Citrus Co., Florida.

DIAGNOSIS.—Sulcus of upper incisor shallow and inconspicuous; anteroposterior diameter of incisor slightly greater than transverse diameter. Post-incisive diastema about 12 mm. in type. Radius of arc formed by enameled incisive face about 7

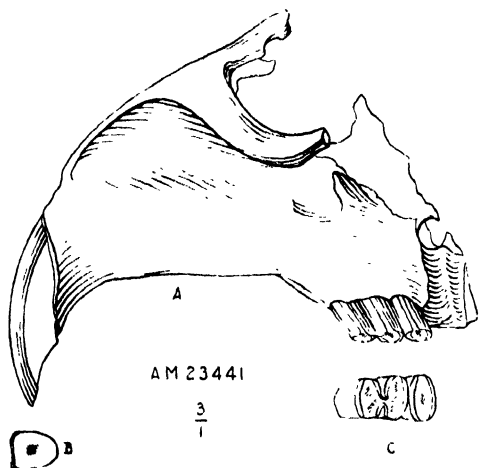


Fig. 1. *Thomomys orientalis*, new species. A, Left lateral view of anterior part of skull, type. B, Transverse section of incisor. C, Crown view of anterior cheek teeth of same. Three times natural size.

mm. Anterior lobe of first cheek tooth markedly broader than long; isthmus between lobes very narrow and short, internal to median longitudinal axis of tooth

series. Length first cheek tooth at alveolus, 2.6 mm.; second, 1.2 mm. Width anterior lobe first cheek tooth, 1.6 mm.; posterior lobe, 1.9 mm.; second cheek tooth, 2.0 mm. Breadth of muzzle below root of zygoma about 6.5 mm.

At the present time *Thomomys* is purely western, not extending east of about 100° W. longitude in the latitude of Florida. In the central and southeastern states its place is taken by *Geomys*, but in this Pleistocene fauna both genera occur. Although the type is fragmentary, generic assignment is not in doubt as upper incisors with a single shallow sulcus on the internal side and P¹ and M¹ with complete posterior enamel plates are shared by no other geomyid genus.

***Synaptomys australis*, new species**

TYPE.—Amer. Mus. No. 23440. Right lower jaw with all cheek teeth. Collected by Carl Sorensen.

HORIZON AND LOCALITY.—Pleistocene, Saber-tooth Cave, Citrus Co., Florida.

DIAGNOSIS.—Pattern of lower cheek teeth as in *S. cooperi*, but enamel relatively thinner and size much larger (about 35%). Total length of molars on surface of wear 8.4 mm. in type.

The most southern members of this genus at present range into North Carolina and Tennessee, but only in the coldest parts of these states. The typical subgenus of *Synaptomys* is hardly distinguishable from *Lemmus* in the lower cheek teeth alone, but the presence of *Lemmus* would be even more remarkable and the pattern is almost identical with that of *S. cooperi*. Confirmation of generic reference is seen in the wholly lingual incisor, terminating opposite M₃; the rootless cheek teeth; the short outer angles in the molars; the presence of cement: M₁ with three truncated outer salients, four inner salients and three closed triangles between the terminal columns.



Fig. 2. *Synaptomys australis*, new species. Crown view of lower cheek teeth, type. Three times natural size.

***Hydrochærus holmesi*, new species¹**

TYPE.—Amer. Mus. No. 23434. Left lower incisor, M₁, and M₃ of one individual. Collected by Carl Sorensen.

HORIZON AND LOCALITY.—Pleistocene, Saber-tooth Cave, Citrus Co., Florida.

DIAGNOSIS.—Cheek teeth slightly larger, M₃ larger relative to M₁, and incisor relatively smaller than in *H. capybara* or *H. xospi*. Plate number of known teeth as in *H. capybara*. Cheek teeth much smaller than in *H. punckneyi* or *H. robustus*. Length M₃ at right angles to axis of growth, 20.5 mm. Width of second plate, 16 mm.

¹The species is named for Mr. Walter W. Holmes, active and successful explorer of the Pleistocene of Florida.

The cheek teeth are slightly larger than those of an unusually robust recent capybara with which they were compared. The incisor is smaller than in the recent form, both absolutely and relatively, and is distinctly less compressed anteroposteriorly. The sulcus is less definite, more rounded, without an angulate bottom. On M_1 the posterior enamel lamina of the second plate is almost plane, rather than concave.

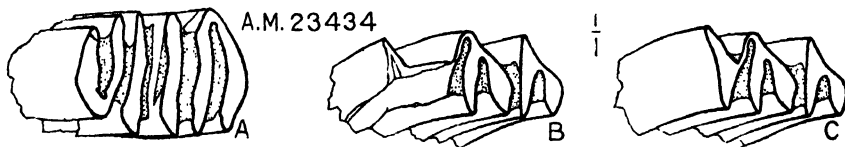


Fig. 3. *Hydrochaerus holmesii*, new species. A, Crown view of M_3 . B, Crown view of M_1 . C, Restoration of M_1 . Natural size.



Fig. 4. *Hydrochaerus holmesii*, new species. Anterior view and transverse section of lower incisor. Natural size.

The most posterior enamel plate of this tooth, on the contrary is concave in section rather than convex. Aside from the size and these slight points, the tooth hardly differs from the recent form. In M_3 the first plate is nearly as wide as the second, joining the latter at its most external point. The third and fourth plates are not arched forward and the internal junction of the last two (fifth and sixth) is unusually strong. The posterior surface is not grooved vertically.

Among described North American fossil species, *H. xesopi* Leidy from the Ashley River, South Carolina, is the closest. The type is a fragment of an upper incisor, but parts of three lower teeth, topotypes but not of quite certain reference, were later described. As Leidy recognized, the known parts do not adequately reveal the distinctions from the recent form. Based on an inadequate type and on doubtfully referred specimens and described in a non-diagnostic way, the status of this species is in doubt. It differs from *H. holmesii* in some of the same particulars as does the recent species—the incisors are larger, the cheek teeth smaller, M_3 smaller relative to M_1 . There are various differences in the minor details of plate structure as figured by Leidy, but these are of doubtful significance.

H. pinckneyi Hay was based on a left M^3 from near Charleston and more complete referred material from Texas later led Hay to erect the new genus *Neochaerus* for this species. The teeth are over 30% larger

than in a robust recent capybara and the plate number of M^3 is said to be larger than in the latter. *H. robustus* Leidy, based on a left P_4 from Nicaragua, is comparable in size to *H. pinckneyi*.

MEASUREMENTS

Lower incisor	Width.....	9.5 mm.
	Anteroposterior diameter.	9.0 mm.
	Length on grinding surface.....	ca. 19 mm.
M_1	Length at right angles to growth axis ...	ca. 18 mm.
	Width of second plate.....	11.0 mm.
M_3	Median length on grinding surface	23.0 mm.
	Median length at right angles to axis of growth. ...	20.5 mm.
	Width of second plate.....	16.0 mm.

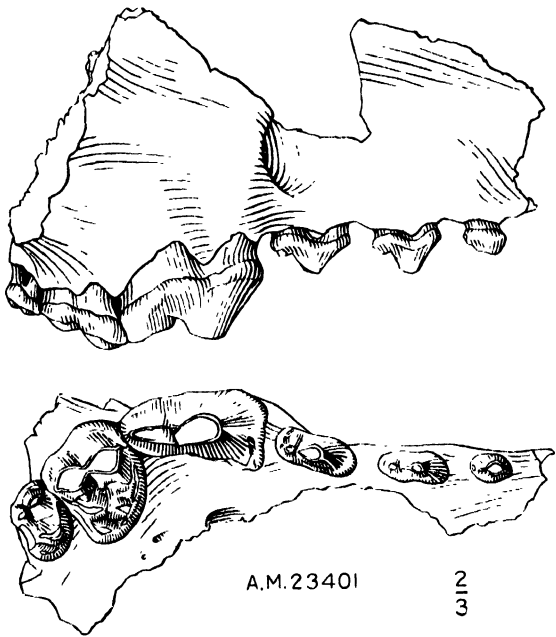


Fig. 5. *Canis ayersi* Sellards. Lateral and crown views of right upper cheek teeth. Referred specimen, Amer. Mus. No. 23401. $\frac{2}{3}$ natural size.

***Canis ayersi* Sellards**

Two specimens seem surely referable to this species, which is the southeastern representative of the large canids generally now referred to *Canis dirus*. One of these specimens, an upper jaw with all the cheek teeth, reveals the characters of M^2 for the first time. The other is a

lower jaw with the canine and P_{1-3} , all much worn. Both specimens are figured and measurements are here given:

Amer. Mus. No. 23401.		Amer. Mus. No. 23400	
P^1	{ Length 8 Width 5.5	C—Maximum diam. of alveolus—13.5	
P^2	{ Length 13.5 Width 6	P_1	{ Length 5 Width 4
P^3	{ Length 16 Width 7	P_2	{ Length 14 Width 6
P^4	{ Length 29 Width 15	P_3	{ Length 15 Width 6.5
M^1	{ Length 18.5 Width 22.5		
M^2	{ Length 10.5 Width 15.5		

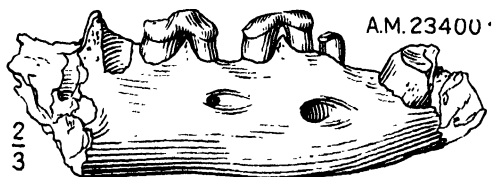


Fig. 6. *Canis ayersi* Sellards. External view of part of right lower jaw. Referred specimen, Amer. Mus. No. 23400. $\frac{2}{3}$ natural size.

A left upper carnassial and jaw fragment in the collection. Amer. Mus. No. 23402, is slightly smaller than in typical *C. ayersi*, the anterointernal heel less prominent and slightly more anterior, the enamel smoother, the diastema between P^3 and P^4 shorter, the infraorbital foramen nearer the alveolar border. Its specific reference is not certain, but separation from *C. ayersi* is not warranted by this material. The carnassial measures 26 mm. in length by 13 in width.

***Lynx rufus* (Güldenst.)**

Dissociated upper and lower jaws, Amer. Mus. No. 23405, are referred to this species. These individuals are slightly smaller than the living *L. rufus floridanus*, but do not differ appreciably in morphology.

The lengths of the preserved teeth are as follows:

P_3 — 7.5	P^3 — 9.0
P_4 — 9.5	P^4 —13.5
M_1 —10.0	

***Smilodon* sp.**

The first fossil found in this cave and that from which it derives its name, Saber-tooth Cave, is an isolated left upper canine, now the property of the Florida State Geological Survey and kindly lent for

inclusion in this study by Herman Gunter, State Geologist. This tooth agrees closely with the fragment from Vero reported by Sellards (Fla. Geol. Surv., 8th An. Rept., p. 152) and referred by Hay (Proc. U. S. Nat. Mus., LVI, p. 106) to *Trucifelis floridanus* Leidy. The type of the latter species is a partial skull, without teeth, from a fissure near Ocala. In the type the maximum diameter of the canine alveolus is given by Leidy (Trans. Wagner Free Inst. Sci., II, p. 15) as 40 mm. Assuming the angle of insertion of the present tooth to have been as in *Smilodon californicus*, its alveolus would have a maximum diameter of about 35 mm. The difference from the type of *T. floridanus* is too great for assurance of specific identity, but not sufficient to contradict the probability.

Like the Vero specimen, the present tooth is relatively slender, strongly compressed, with sharp, serrated edges both anteriorly and posteriorly, and it tapers more rapidly than the corresponding tooth of *Smilodontopsis conardi* Brown.

Two distal ends of humeri were also found. They differ in detail, one being slightly larger, with the entepicondylar foramen more elongate, higher, covered by a more slender bridge of bone, but they may represent the same species. They do not agree exactly with any remains previously described, differing from *Smilodon californicus* chiefly in their smaller size, less expanded distal ends, less projecting entepicondyles—but their minor morphological features are of little interest until specific association may be established.

Megalonyx cf. wheatleyi Cope

A species of *Megalonyx* is represented in the cave by several teeth and limb bones. They differ from the common *M. jeffersonii* (Desmarest) in their uniformly smaller size and also, at least as regards the foot bones, in various specific morphological characters. The teeth agree in size with some specimens referred by Cope to his *M. wheatleyi*. The Florida specimens may well represent a new species, but so many dubious species of this genus have already

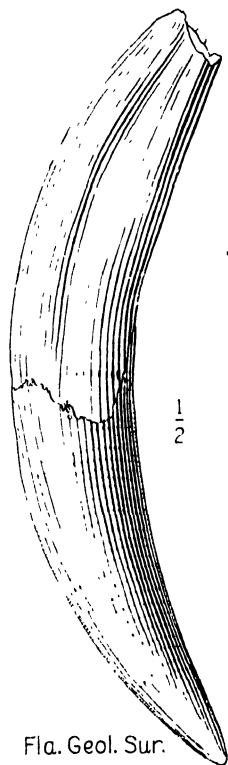
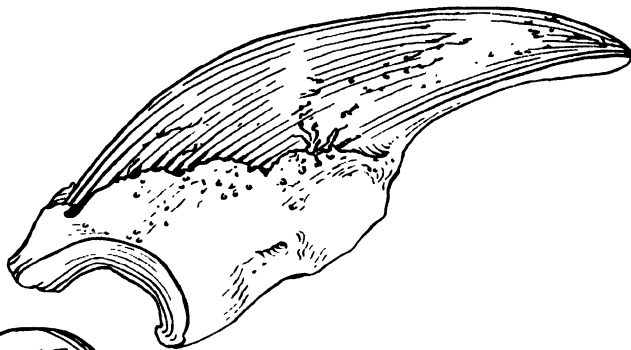
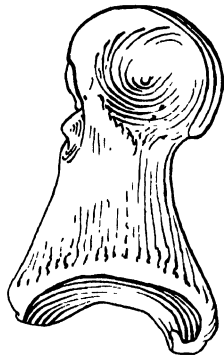


Fig. 7. *Smilodon* sp. External view of left upper canine in collection of Florida State Geological Survey. $\frac{1}{2}$ natural size.

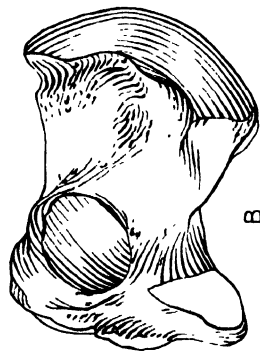


A

A.M. 23423



A.M. 23424



B

Fig. 8. *Megalonyx* cf. *wheatleyi* Cope. A, Left fourth metatarsal and phalanges, internal view. B, Left second metatarsal, internal view.
 $\frac{2}{3}$ natural size.

been established on fragmentary remains that the application of a new name would be unjustified. The teeth, similar in form to those of *M. jeffersonii*, have the following dimensions:

First upper tooth.....	{ Maximum diameter.	32.5 mm.
(Amer. Mus. No. 23421)	{ Maximum transverse diam.	16.0 mm.
First lower cheek teeth.....	{ Maximum diameters.....	30, 31
(Amer. Mus. No. 23422)	{ Maximum trans. diams.....	16, 15.5
Fourth (?) upper tooth.....	{ Anteroposterior.....	13.5
(Amer. Mus. No. 23420)	{ Transverse.....	19

The foot bones may be compared with those of *M. jeffersonii* described by Leidy from Kentucky (Memoir on the Extinct Sloth Tribe, etc., 1855; pp. 42-5, Pl. XIII). The proximal end of a second metatarsal from the cave is relatively deeper than in Leidy's specimen, its inferior angle more produced; the tarsal articular surface emarginate inferoexternally, extending farther above and superoexternally; the shaft relatively deeper and less concave anteroposteriorly above. On metatarsal IV the shaft is relatively stouter than in Leidy's material; the process for metatarsal V less projecting, that for metatarsal III somewhat less elongate. The preserved phalanges do not appear to be very distinctive save in dimensions. Measurements follow:



Fig. 9. *Chlamytherium septentrionale* (Leidy). Lateral and crown views of anterior tooth, Amer. Mus. No. 23427. Natural size.

Left metatarsal II, Amer. Mus. 23424:

Length.....	67 mm.
Breadth of shaft.....	34 mm.
Depth proximal end.....	46 mm.
Depth distal articulation (obliquely).....	49 mm.

Fourth metatarsal and digit, Amer. Mus. No. 23423:

Metatarsal IV: Minimum circumference of shaft.....ca. 106 mm.

Length.....	91 (slightly broken)
Depth distal end.....	52 mm.
Maximum diameter distal end.....	59 mm.

	Phal. 1.	Phal. 2.	Phal. 3.
Maximum length	35	69	128
Maximum width	42		
Maximum depth	51		47 (without sheath)
Prox. end { width		35	
{ depth		40	
Shaft { width		29	
{ depth		20	
Dist. end { width		24	
{ depth		30	

***Blastocerus extraneus*, new species¹**

TYPE.—Amer. Mus. No. 23457. Part of right lower jaw with P_2 — M_2 . Collected by Carl Sorensen.

HORIZON AND LOCALITY.—Pleistocene, Saber-tooth Cave, Citrus Co., Florida.

DIAGNOSIS.—Tooth pattern and proportions of type similar to *B. dichotomus*, but P_2 somewhat more elongate; P_3 — P_4 relatively shorter; P_4 with heel relatively longer externally and with anterointernal infold open to base, not forming a closed lake with advancing wear; posterointernal crests of premolars directed more internally; anterior lobe of M_1 of nearly the same basal width as the posterior lobe.

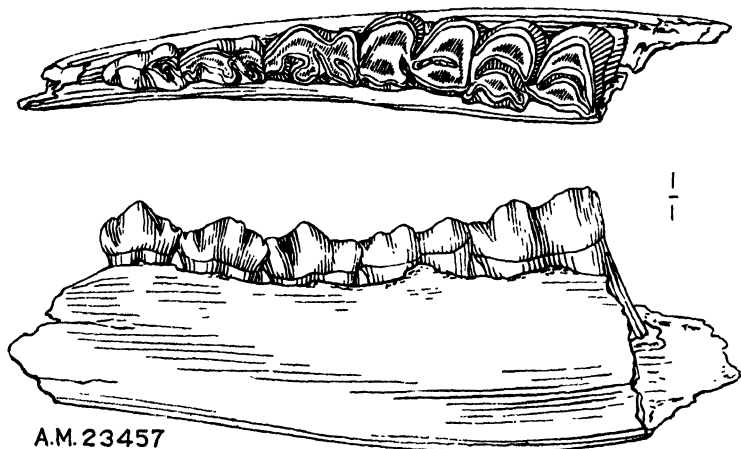


Fig. 10. *Blastocerus extraneus*, new species. Crown and internal views of type lower jaw. Natural size.

The younger gray sand and humus contained very numerous remains of deer, the common *Odocoileus osceola*. In the older cave earth there were only three cervid jaws, the present specimen and two belonging to *O. osceola*.

Unlike *Odocoileus*, P_4 of this specimen has almost the same structure as P_3 , the chief difference, aside from proportions, being that the metaconid or second internal pillar projects farther forward. If constant, the structure of P_4 might be a generic distinction, even from *Blastocerus*, but this tooth varies considerably in recent deer. *Blastocerus* may approach this type very closely and is normally much more similar to it than is any of a large series of *Odocoileus* dentitions which have been compared. A small median external style is present on M_1 but absent on M_2 . This again may be individual, but exactly the same condition is seen in recent *Blastocerus* teeth used for comparison.

The small posterior mental foramen is distinct and is beneath the anterior root of P_2 . The jaw is slender for a mature animal, measuring 23.5 mm. in depth below the middle of M_2 internally.

¹The nomenclature of the South American cervids is rather confused. *Blastocerus* is used to imply relationship with the marsh deer. The same generic term is sometimes used for the Pampas deer, which is apparently not so closely related.

The presence in this fauna of a deer apparently related to one hitherto known only in South America is a very striking feature, although it has long been recognized that a strong South American element occurs in the Florida Pleistocene.¹ The nature of the available material, which is suggestive but not at all conclusive, should discourage theorizing. Nevertheless, while recognizing the strong factor of individual variation, some specimens of *Odocoileus* approaching this jaw in character and some of *Blastocerus* diverging from it more than others, it yet seems improbable that all of the points of difference from *Odocoileus* and of resemblance to

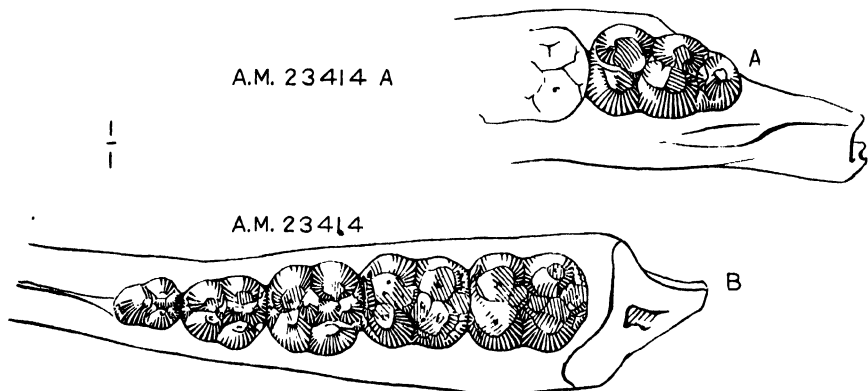


Fig. 11. *Mylohyus* cf. *browni* Gidley. A, Crown view of M_3 , from Amer. Mus. No. 23414A. B, Crown view of left P_2 - M_2 , from Amer. Mus. No. 23414. Natural size.

Blastocerus are misleading. Among these may be stressed the large P_2 with the lobe anterior to the main apex relatively distinct and elongate; the rather open anterior fossette of P_4 , opening internally well back of the anterior end of the tooth; the distinctly bifid anterointernal column of P_4 ; the metaconid of this same tooth without vertical internal grooves, little compressed laterally, and projecting only anteriorly from the loph to the protoconid; and the relatively large molars.

Measurements follow:

P_2		P_3		P_4		M_1	
Length	Width	Length	Width	Length	Width	Length	Width
11	6	11.5	7	12	8	16	10
M_2							
Length	Width						
18	11						

¹"South American element" is a phrase often loosely used. It has been made to include (1) animals indigenous in South America and introduced into North America (e.g., glyptodonts), (2) others autochthonous in North America but with their nearest surviving relatives now mainly South American (e.g., tapirs), and (3) possibly also some instances of races derived in South America from rather recently introduced northern stocks and reintroduced in altered form into North America (no cases certainly known, but possibly true of several animals usually considered as examples of the second sort).

***Mylohyus* cf. *browni* Gidley**

Aside from isolated canines, peccaries are represented in the cave by two lower jaws of a single species of *Mylohyus*, Amer. Mus. Nos. 23144 and 23144A. The Pleistocene peccaries are not as yet very well understood, but of described forms these agree most closely with *Mylohyus browni* from Arkansas. The chief differences, all of doubtful value, are the shorter distance between the end of the symphysis and the cheek teeth, smaller P_2 , and slightly shorter cheek tooth series. The length of M_{1-3} is 52 mm., as against 54 in *M. browni*, that of P_{2-4} is 34 mm., 37.5 in *M. browni*, and the greatest transverse dental width, across the anterior lobe of M_2 , is 14 mm. in the cave specimen and 15 mm. in *M. browni*. As in the latter species, the heel of M_3 consists essentially of a single cusp, and the dental structure, in general, is almost identical.

56.9 (117.51.7)

FURTHER NOTES ON MONGOLIAN CRETACEOUS
MAMMALS¹

BY GEORGE GAYLORD SIMPSON

In 1923 the Third Asiatic Expedition discovered a mammal skull in the Cretaceous Djadokhta Formation of Mongolia—the second partial Mesozoic mammal skull ever to be described.² Upon learning the importance of this specimen, which was still in the matrix and of doubtful relationships as it left them, the members of the expedition turned with renewed energy to searching for further material of the same sort. Their persistence was richly rewarded with no fewer than six additional partial skulls, as well as fragments indicating two other individuals. These specimens, found in 1925, were described the following year.³

Further collecting has been impossible, but in cleaning up the material already obtained from the Djadokhta an important new find was made. Imbedded and almost completely hidden in a sandstone nodule collected in 1925 was a partial skull representing a new species of *Zalambdalestes*. This skull shows the characters of the upper cheek teeth much more plainly than any of the earlier material and also is the first in which the complete posterior part of the mandible, with the important angular region, is preserved. There are also associated with the skull a broken femur and part of a pelvis—fragmentary but very welcome additional information as to the structure of this genus. Preparation of the first mammal discovered has also revealed some skeletal remains of *Djadochtherium* which were not available at the time of the original description and which prove to be of considerable importance. Description of this additional material and its correlation with what was already known are the aims of the present paper.

¹Publications of The Asiatic Expeditions of The American Museum of Natural History. Contribution No. 84.

²Simpson, G. G. 1925. A Mesozoic Mammal Skull from Mongolia. American Museum Novitates, No. 201.

³Gregory, W. K. & Simpson, G. G. 1926. Cretaceous Mammal Skulls from Mongolia. American Museum Novitates, No. 225.

There are now known from the Djadokhta Formation eight partial skulls with associated portions of lower jaws, one skull without jaws, a fragment of a maxilla, and part of a mandible, the remains of eleven individuals in all. These have been assigned to five genera and six species, as follows:

MULTITUBERCULATA

Ptilodontidae

Djadochtherium matthewi Simpson.

INSECTIVORA

Deltatheridiidae

Deltatheridium pretrituberculare Gregory & Simpson.

Deltatheroides crelacicus Gregory & Simpson.

Hyotheridium dobsoni Gregory & Simpson.

Zalambdalestidae

Zalambdalestes lechei Gregory & Simpson

Zalambdalestes grangeri Simpson.

The affinities of the members of this small but unusually important fauna have already been briefly discussed and are to be taken up later in more detail.

The new material, like that already described, was discovered by the Third Asiatic Expedition under the leadership of Roy Chapman Andrews, Walter Granger in charge of paleontology, and has been skillfully prepared by Albert Thomson. The drawings in this paper are by John Germann.

Zalambdalestes grangeri, new species

TYPE.—Amer. Mus. No. 21709. Most of facial portion of skull with right cheek teeth, associated with fragment of lower jaw and with partial pelvis and femur.

HORIZON.—Djadokhta Formation, Upper Cretaceous.

LOCALITY.—Shabarakh Usu, Outer Mongolia. 1925.

SPECIFIC CHARACTERS.—P³⁻⁴ about as in *Z. lechei*, but molars all more robust and longer relative to their widths.

Although the specimen cannot be made to enter into the genotypic species, it is unquestionably closely related and belongs to the same genus, the characters of which it helps to establish more definitely.

DENTAL FORMULA: One of the most valuable contributions of the new skull is that it clears up some doubts as to the homologies of the teeth and as to the dental formula. The latter may now be given as $\frac{18.1.2.3}{9.1.3.3}$. The upper incisors were most doubtful, and they remain so, as this region is lacking in No. 21709. There is a large caniniform tooth preceded and followed by diastemata and inserted at a point

nearly two-thirds of the distance from the anterior end of the premaxilla to its suture with the maxilla. This must be an incisor, and from its position is probably not I^1 . We indicated the possibility of their being a small I^3 close to the posterior end of the premaxilla and therefore tentatively called the enlarged tooth I^2 . It should, however,

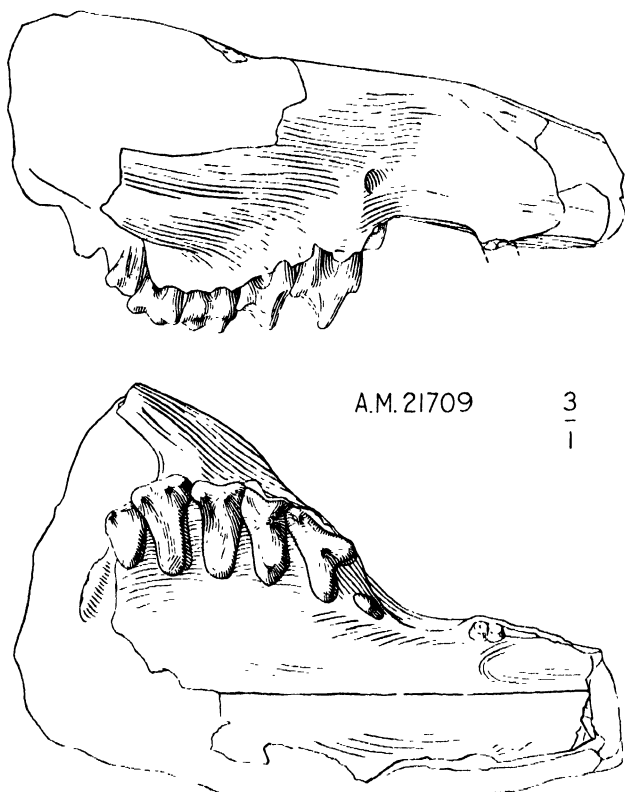


Fig. 1. *Zalambdalestes grangeri*, new species. Right lateral and palatal views of type skull. Three times natural size.

be stated that this region is obscure in the two specimens which show it (21708 and 21704) and that the presence of the tooth called I^3 is not certain. Further discussion would be futile and the only positive fact is the presence of a large lateral caniniform incisor.

CANINE: In the earlier paper the small two-rooted tooth in the middle of the diastema was considered as either P^2 or the canine but

comparison was especially with P² of other insectivores. For a canine it is aberrant, although not altogether unique, in its position far back of the maxillo-premaxillary suture. P² is now definitely recognized posterior to it, however, so that it must be the canine or P¹. It is rather small, two-rooted, and relatively posterior, hence much like a premolar, but in the most nearly comparable later mammals P¹ is often lacking, while the canine is never lacking, is often two-rooted, relatively small and premolariform, and is occasionally some distance back of the suture, so that it seems necessary to consider this tooth as the canine.

PREMOLARS: The real P² was not previously distinguished, but it is clearly shown in the present skull and, with this help, is now also found to be indicated in the previous material. It is a very small tooth close to P³ and immediately below the infraorbital foramen. The palate narrows abruptly here and the long axis of the tooth follows the oblique dental border, running anterointernal—posteroexternally. The crown is simple, compressed, with but a single cusp and no cingula.

The five large cheek teeth, although somewhat worn, are better preserved than in any other known Djadokhta mammal and their structure may now be definitely set forth for the first time. Our earlier conjectures are, on the whole, well confirmed.

P³ has a high, piercing, main cusp surrounded by three lesser cusps. The main cusp is not central, but nearer the external border. Directly anterior to it is the small parastyle, while the metastyle, equal in height to the ps but more distinctly separate from the main body of the tooth, projects posteroexternally as a spur. A similar spur of equal length but somewhat lower projects internally and somewhat anteriorly from the main cusp. This heel-like cusped spur is clearly the equivalent of the protocone of the molars.¹

P⁴ is similar to P³ in structure, but is wider, with the parastyle anteroexternal to the main cusp and the protocone spur larger. This tooth is closely similar to the true molars in form, but is sharply distinguished by the fact that there is only one main external cusp instead of two and that this cusp is somewhat farther from the external border than the paracone and metacone of the molars and larger than either.

¹The Osbornian cusp terms are accepted without reference to theories as to order of development but as morphological terms applicable to molars and molariform premolars alike. This usage is becoming established in the literature and its advantages seem obvious.

M¹ and M² are of the same structure save that M² is wider transversely and has the parastyle the more external instead of the metastyle, as in P^{3,4}, or instead of having both nearly equally external as in M¹. These teeth are tritubercular but are very short and wide, being more elongate transversely than in any other known insectivore and approached in this respect only by some of the zalambdodonts (cf. *Ericulus*, *Chrysochloris*). The structure, however, is quite different from that of any recent zalambdodont. The paracone and metacone are lateral in position, separated only by the narrow cingulum from the external border of the tooth. They are subequal and are rather more distinct than the earlier material suggested. The bases are to a certain degree confluent, but hardly more so than in *Ictops*, for example. The parastyle and metastyle are small and are united across the outer face of the crown by a narrow cingulum. Internally there is a stout protocone, much worn in this individual but apparently originally not quite as high as the paracone and metacone. The crown between the outer and inner cusps is hollowed out by wear. There is no trace of a hypocone or of an anterior cingulum.

M³ is a small tooth, not so wide in proportion to its length as the preceding molars. The paracone is larger than the metacone and there appears to be no metastyle.

LOWER DENTITION: No new material of the lower dentition has been found and the figures accompanying the earlier paper reveal what is known. A few words must be added to the verbal description. The hypoconulid cannot be distinguished on M₁₋₂ in the available material but in M₃, as mentioned, it is distinct and close to the entoconid. The paraconid is internal on all the molars and is probably slightly lower than the metaconid, although this is not certain. Paraconid and metaconid are closely approximated. On P₄ the paraconid is more distinct and slightly more external, but is lower than on the molars. The heel of P₃ has but a single cusp and seems to slope downward externally.

As seen in No. 21704, P₂ occludes just posterior to the upper canine, hence well in advance of P² and not in contact with it. The



Fig. 2. *Zalambdalestes grangeri*. Diagram of right upper cheek teeth. Arrow follows the main apices of premolars and molars. Twice natural size.

tip of P_3 seems to pass just internal to P^2 . A wholly incisiform semi-procumbent tooth, which must be the homologue of the lower canine, passes just anterior to the upper canine and comes lightly in contact with it.

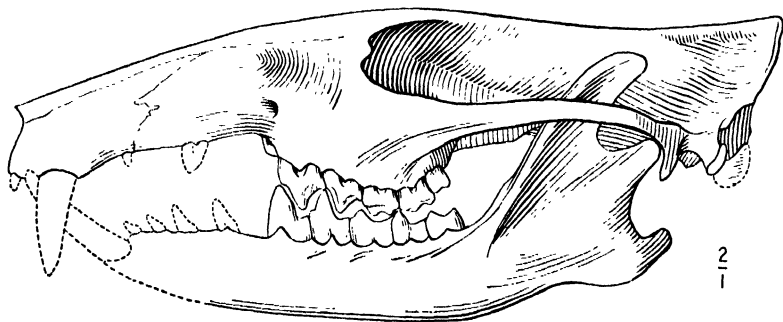


Fig. 3. *Zalambdalestes lechei* Gregory and Simpson. New composite reconstruction of skull and jaws, left lateral view. Twice natural size.

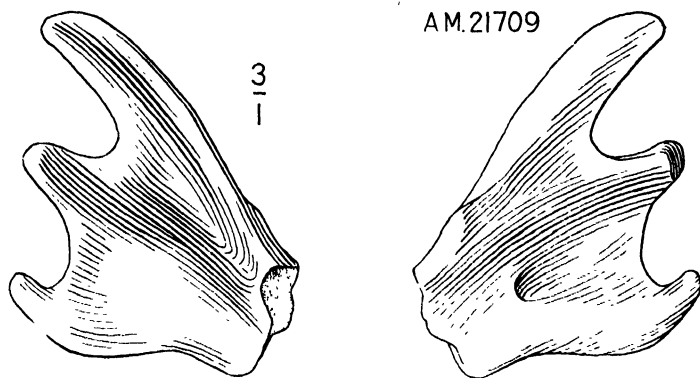


Fig. 4. *Zalambdalestes grangeri*. Posterior part of right lower jaw of type, external and internal views. Three times natural size.

SKULL: The new skull fully confirms our belief that the large opening in the base of the anterior end of the zygoma of No. 21708 is artificial. In the present specimen this region is better preserved and a thin plate of bone is here seen, slightly hollowed out, probably for the origin of well developed snout muscles.

MANDIBLE: In our earlier material the angular process of the mandible was lacking and the coronoid process, while apparently complete, had probably lost its apex. With No. 21709, however, is

associated the completely preserved postdental portion of the right mandible, and the earlier restoration must be modified. The coronoid is long and slender, extending farther back than the condyle. The angle is a small, pointed, hook-like process, not at all inflected. The external surface of the base of the coronoid is excavated. On the internal surface, the region anteroinferior to the condyle is broadly concave and near the anterior end of this shallow excavation is the large dental foramen. Although distinctive, this whole posterior part of the mandible finds fairly close comparison with *Potamogale* among zalambdodonts or with some of the erinaceomorphs, such as *Necrolestes* or *Galerix*.

SKELETAL REMAINS

In the same nodule of reddish sandstone which yielded skull No. 21709 were a number of skeletal fragments. Besides some indeterminate fragments, distal caudal vertebrae, etc., there were found parts of a pelvis and femur and, at a little distance from these, another pelvis nearly complete with the sacrum, anterior caudals, and some limb bones. On further development the second pelvis and associated material proved to belong to a small reptile, but the other pelvis and femur are mammalian and their size and general characters strongly confirm the natural inference that they belong to the same individual as the skull.

PELVIS: The pelvis is clearly of insectivore type, but is rather peculiar in detail. The acetabulum is deep and about one third of it was apparently formed by the pubis, which is lacking. The ischium just back of the acetabulum is a stout bone nearly oval in section. The ilium, which is complete save for a very small portion of the anterior end, is not blade-like or compressed laterally and is triangular in section throughout. The crista lateralis is prominent and divides the lateral aspect of the bone into nearly equal dorsal and ventral portions. The iliopectineal tubercle is well marked, purely ventral in position, and close to the ilio-pubic symphysis. The anteroinferior iliac spine is also quite distinct and is at the posterior end of the crista

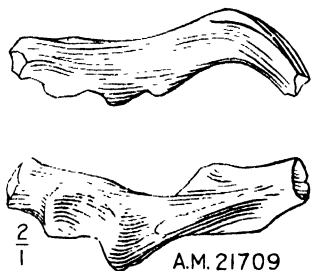
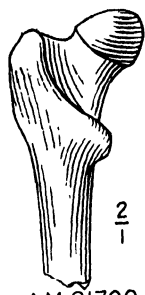


Fig. 5. *Zalambdalestes gran-geri*. Pelvis associated with type. Superior and external views of right ilium and part of ischium. Twice natural size.

lateralis, immediately anterior to the acetabulum. The ventrolateral face of the ilium is concave throughout. The dorsolateral face is convex posteriorly, above the spina anterior inferior ilii and the posterior portion of the crista lateralis, but anteriorly, in the region for the origin of the gluteus medius, it becomes hollowed out. Just at the anterior portion of the sacro-iliac joint the dorsal (or dorsoposterior)



A.M. 21709

Fig. 6. *Zalambdalestes grangeri*. Semidiagrammatic restoration of proximal portion of left femur associated with type. Posterior (ventral) view. Twice natural size.

edge of the ilium is produced into a relatively large plate-like crest, similar to that common in the Creodonta but usually less prominent or absent in the Insectivora. Anterior to this crest and to the sacroiliac joint the ilium turns sharply outward and projects anterolaterally and somewhat upward, free of the vertebral column. This pelvis, basically primitive but with strongly marked muscle insertions and a certain peculiar aspect of its own, suggests a strong pelvic musculature. It is far the oldest mammalian pelvis so far discovered

FEMUR: Only the proximal portion of the femur is preserved and this is imperfect, but can be restored with certainty. It is at a definitely higher evolutionary level than any of the known Jurassic femora and agrees with the rest of the evidence in marking *Zalambdalestes* as a member of the basic true placental stock.

The head projects at an angle to the shaft, but the neck is not markedly constricted. The greater trochanter projects nearly as high as the head, from which it is separated by a very shallow notch. It is compressed transversely, and a strong curving crest runs downward and then internally from it to the lesser trochanter which is large and quite internal in position. Just beneath this crest is the deep digital fossa. The presence or absence of a third trochanter cannot be determined.

MEASUREMENTS

	<i>Zalambdalestes grangeri</i> No. 21709	<i>Z. lechei</i> No. 21708
P ³⁻⁴ ant.-post., ext.	5.3 mm.	5.3 mm.
M ¹⁻³ a.-p., int.	5.3	4.5
M ¹⁻³ a.-p., ext.	6.3	5.4
P ³ -M ³ a.-p., ext.	10.8	ca. 9.9
M ¹ a.-p., ext.	2.5	2.1
M ¹ transverse	4.1	4.0
M ³ a.-p., ext.	1.7	ca. 1.4
M ³ trans.	2.7	ca. 2.6

Measurements of teeth so small and irregular may differ even several percent if taken at different times or by different observers. The above were taken with proportional dividers under a microscope and repeatedly checked and compared. Reasonable allowance has been made when necessary for the more eroded teeth of No. 21708, so that, if anything, the differences between the two are minimized.

***Djadochtatherium matthewi* Simpson**

When the type skull of *Djadochtatherium* was described, preparation of the associated fragments was not complete. Mr. Thomson has since completed his skillful work, revealing several associated foot bones, five fragmentary vertebrae, the lower end of a scapula, a large part of a humerus, ribs, and several other fragments. These were all found in direct association with the skull and jaws and there is every reason to consider them as parts of the same individual. Incomplete as they are, these remains are of great interest and significance and this occasion is taken to describe them in some detail.

The proximal epiphysis and much of the shaft of the right *humerus* are preserved. While it agrees in a general way with the only other multituberculate humerus so far described,¹ that of *Ptilodus*, it differs somewhat in detail and permits a more thorough description of the known parts than that given by Gidley. As he has pointed out, the humerus in this Order is entirely unlike that of the monotremes and stands at the same evolutionary level as that of the most generalized placentals and marsupials.²

The head is large, the articular surface forming part of a sphere and only slightly elongated anteroposteriorly. The tuberosities are

¹Gidley, J. W. 1909. Notes on the Fossil Mammalian Genus *Ptilodus*, etc. Proc. U. S. Nat. Mus., XXXVI, 611-26. Humerus, p. 620.

²Gidley states that it is "eutherian throughout" and with this all would agree if by "eutherian" evolutionary status and not positively indicated relationship were meant. Broom has criticised this statement, apparently overlooking the fact that the term "Eutheria" as originally proposed by Gill included both marsupials and placentals and that Gidley was obviously using the term in this sense.

widely separated and neither is enlarged. The bicipital groove is broad and shallow and merges imperceptibly into the anterodistal face of the shaft. The crest of the lesser tuberosity is moderately prominent and becomes gradually lower and more rounded as it passes distally. The deltoid ridge is, as stated by Gidley for *Ptilodus*, "well developed but not highly specialized." Proximally it bears a triangular flattened surface, about 3 mm. wide near the greater tuberosity and narrowing distally so that the apex of the ridge becomes

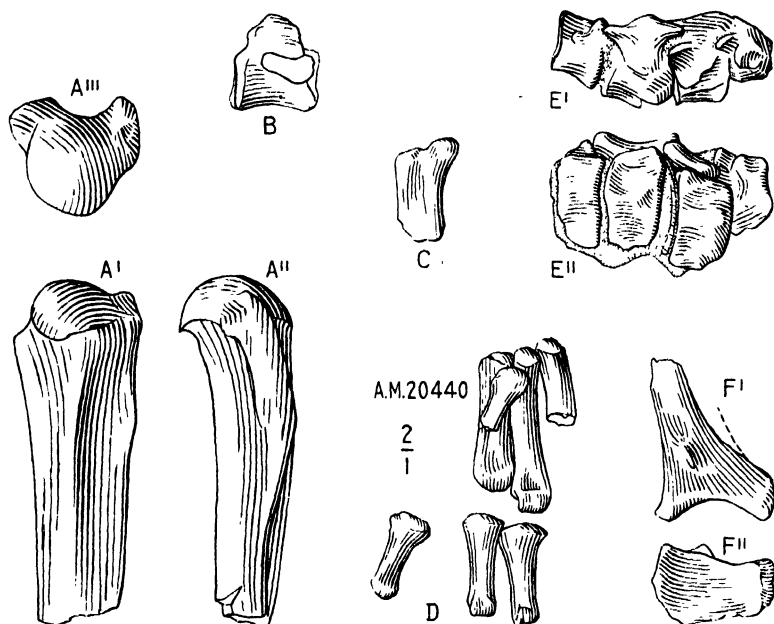


Fig. 7. *Djadochtatherium matthewi* Simpson. Skeletal fragments associated with type. A', right humerus, posterior view. A'', same, external view. A''', same, proximal view. B, Lumbar vertebra, lateral view. C, Head of rib. D, Metacarpals and proximal phalanges, palmar view. E', Articulated dorsal vertebrae, lateral view. E'', same, ventral view. F', Right scapula, lateral view. F'', same, inferior view of glenoid cavity.

single and sharp at a point estimated to be about 15 mm. from the top of the greater tuberosity. About 6 mm. of the ridge is preserved below this point and in this distance, which must carry it well below the middle of the shaft, it becomes only slightly less prominent and remains sharp, bordered by concave surfaces on both sides. There

is also a ridge, quite definite and fairly sharp at first but becoming rounded distally, extending down the posteromedian part of the humerus from below the head to the end of the part preserved. This ridge, the crest of the lesser tuberosity, and the deltoid ridge make the shaft definitely triangular in section, dividing it into a broad, slightly concave anterior face, a narrow concave posterolateral face, and a still narrower posteromedial face which is concave proximally but becomes somewhat convex distally.

Only a fragment of the right scapula is preserved but it is at present the only multituberculate scapula known and is therefore important. The glenoid cavity is complete, but only a portion of the blade remains. The relationship of glenoid cavity to blade is exactly that of higher mammals and fundamentally unlike that in monotremes. The blade narrowed just above the glenoid and was backwardly directed—another point of marked resemblance to higher mammals and marked dissimilarity to monotremes. The glenoid cavity is elongate anteroposteriorly and somewhat wider posteriorly. The posterolateral angle projects slightly and is pointed. The cavity fits the head of the preserved right humerus perfectly, allowance being made for the thin articular cartilage, and confirms their natural association.

The importance of this scapula is that it seems to settle much discussion as to the multituberculate shoulder girdle and agrees with much other evidence in showing that the multituberculates were in at least a metatherian¹ stage of evolution and cannot possibly have been ancestral or closely related to the monotremes. In 1889 Marsh described under the name *Camptomus amplius* a scapula, interclavicle, and other fragments (the association of which with the reptile-like shoulder girdle was admitted to be doubtful). This clearly reptile-like shoulder girdle was considered as probably, or possibly, allotherian (multituberculate)² and as such, without due regard for the hesitation which Marsh himself expressed and for the fact that reptiles to which parts of this dissociated shoulder girdle could well belong are known to occur in the same formation, it has become firmly fixed in the literature, popular and scientific. Thus Broom cites it in the course of his valuable discussion of multituberculate affinities.³ Broom also believed the pectoral girdle to be known in *Ptilodus*, so identifying the

¹This does not mean that they were related to the Marsupialia.

²Marsh, O. C. 1889. Discovery of Cretaceous Mammalia. Am. Jour. Sci., (3) XXXVIII, 81-92. *Camptomus*, p. 87.

³Broom, R. 1914. On the Structure and Affinities of the Multituberculata. Bul. Am. Mus. Nat. Hist., XXXIII, 115-134. *Camptomus*, p. 125.

element called the pelvis by Gidley.¹ Further discoveries quickly showed that Gidley was correct with regard to *Ptilodus*.² and the present specimen shows that Marsh and those who have followed him were probably incorrect in referring the *Camptomus* fragments to a multituberculate. *Djadochtatherium* is a typical multituberculate, older than the Lance, whence *Camptomus* was derived, and it certainly can have had neither reptile-like coracoid nor interclavicle, although of course rudiments of the more typically reptilian elements may have been present as they are in many primitive marsupials and placentals.

The preserved foot bones probably belong to the right manus and consist of four *metacarpals*, two of them complete, and three proximal *phalanges*. The proportions and general aspect of these bones are quite comparable to those familiar in primitive marsupials and placentals. Metacarpal II is 9.1 mm. long; Met. III, 10.8 mm.; 1st phalanx II, 6.9 mm.; 1st phal. III, about 7.0 mm. The middle portion of the shaft of met. III measures 2.0 mm. in transverse diameter. The bases of metacarpals II and III are closely appressed, somewhat narrowed transversely, and the articular surfaces for the carpals are nearly featureless, approaching simple sections of transverse cylinders and extending, at least on met. II, somewhat farther on the dorsal than on the volar side. The external overlap of the proximal ends common in primitive mammals is either very slight or absent. The shafts of these bones are gently arched, their dorsal surfaces nearly straight and volar surfaces slightly concave. The heads (distal ends) are very little expanded. The surfaces for the phalanges are also transversely cylindrical and extend farther on the volar than on the dorsal side. Keels are absent or, possibly, very faintly indicated at the volar end of the articular surface.

The proximal end of met. I lies in the specimen below that of met. II. Its base is more equidimensional, the carpal articulation rounded. The shape of this surface, the absence of any evidence of pressure against met. II, and its displacement in a foot which was articulated when buried all point to the first digit as being more freely movable than the others and very probably opposable to them.

The first phalanges are expanded proximally and the articular surfaces for the metacarpals are simple and only slightly concave. The distal ends are slender and not expanded. The articular surfaces

¹Gidley, *loc. cit.* sup., p. 621.

²Note by Walter Granger to Broom's paper, *loc. cit.*, p. 134.

for the second phalanges also extend farther on the volar side and each has a shallow median groove ending in a slight notch at this end.

These foot fragments definitely suggest a mobile, slender forefoot with an opposable pollex.

The vertebrae include four partial anterior dorsals in articulation and a single isolated vertebra of different character. These are all poorly preserved and their description provisional. The centra of the four associated vertebrae are depressed and are wider than long. On the second and third of the four there is a small posteromedian process on the lower part of the centrum and also small posterolateral processes. These all appear to be absent on the first preserved vertebra and this region is broken off on the fourth. There appear to be no true transverse processes. The nerves probably issued through posterior notches in the bases of the neural arches. The zygapophyses are simple, their articular faces plane and nearly horizontal, but facing a little outward on the post- and inward on the prezygapophyses. The upper parts of the neural arches are broken off. The isolated vertebra, which was found in the same nodule, has a higher and narrower centrum, slightly longer than broad, concave and slightly keeled on the lower surface, and has strong transverse processes. On the four articulated vertebrae facets for ribs appear to be present, although not clear, and two ribs were found very close to them, but there are no rib facets on the isolated vertebra, which must be a lumbar.

The ribs are exemplified by numerous fragments, showing little beyond the fact that capitulum and tuberculum are distinct, close together but separated by a notch, and that the main body of the rib is compressed anteroposteriorly and elliptical in section.

Corrections for Novitates No. 225

This occasion is taken to correct the following errors in our former paper, *Novitates No. 225*.

- p. 1, l. 14 & l. 20. For "1924" read "1923."
- p. 1, l. 22. Delete "and family."
- p. 4, l. 10 of legend to Fig. 1. Insert "H," before "H".
- p. 9, legend to Fig. 8. For " $x_1/1$ " read " $x_2/1$."
- p. 9, l. 18-19. Read "The palate is of comparable width throughout internal to the alveoli," etc.
- p. 9, l. 2 from bottom. For " $P^{2.4}$ " read " P_{2-4} "
- p. 14, l. 21. After " P_3^3 or 2 " insert " M_3^3 ."

- p. 15, legend to Fig. 13. For " $x_{2/1}$ " read "x slightly less than $2/1$."
- p. 16, legend to Fig. 14. For " $x_{2/1}$ " read " $x_{3/2}$."
- p. 17, 1.8. For " P_4 " read " P_3 ."
- p. 17, 1.9. For " P_4 " read " P_4 ."
- p. 20, Fig. 19. The left view is of the internal aspect and would be correctly oriented if rotated clockwise about 150° .

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AFFINITIES OF THE MONGOLIAN CRETACEOUS INSECTIVORES¹

BY GEORGE GAYLORD SIMPSON

The unique series of Mesozoic mammal remains found by the Third Asiatic Expedition in Mongolia has now been completely described in a series of three papers.² The affinities of the one known multituberculate, *Djadochtherium matthewi*, were as thoroughly discussed as the material warrants in the first paper, and no additional remarks seem necessary. The relationships of the more important insectivores, however, were only briefly discussed in the second paper and a review of the evidence, especially including the important new details given in the third paper, suggests some modification and amplification of the views already presented.

Not only are these mammal remains by far the most complete ever discovered in the Mesozoic, but they also occupy a very strategic position in time and in space which makes close scrutiny of their relationships essential. In time they occur in the Cretaceous, when, according to theories formed before their discovery and based largely on early Tertiary mammals, the differentiation of the placental orders should be in progress and not yet far advanced. In space they occur in Central Asia in or near the region which a number of students, especially Osborn and Matthew, have considered as an important center of radiation and probably the very one whence came the groups of mammals which appear to have entered North America and Europe suddenly at the beginning of the Tertiary and which must have been undergoing an important deployment during upper Cretaceous time. The Mongolian Cretaceous insectivores are thus actual representatives, so long hoped for but so little expected, of a group hitherto hypothetical and known only by its presumed descendants.

¹Publications of the Asiatic Expeditions of the American Museum of Natural History. Contribution No. 85.

²Simpson, G. G. 1925. A Mesozoic Mammal Skull from Mongolia. American Museum Novitates, No. 201.

Gregory, W. K. and Simpson, G. G. 1926. Cretaceous Mammal Skulls from Mongolia. American Museum Novitates, No. 225.

Simpson, G. G. 1928. Further Notes on Mongolian Cretaceous Mammals. American Museum Novitates, No. 227.

These insectivores have been placed in two families, four genera, and five species:

DELTATHERIDIIDAE Gregory and Simpson

Deltatheridium pretrituberculare Gregory and Simpson

Deltatheroides cretacicus Gregory and Simpson

Hyotheridium dobsoni Gregory and Simpson

ZALAMBDALESTIDAE Gregory and Simpson

Zalambdalestes lechei Gregory and Simpson

Zalambdalestes grangeri Simpson

Zalambdalestidae

PARATYPE SKULL OF *Zalambdalestes lechei*.—The classification of the specimens referred to *Z. lechei* is minor relative to the broader relationships here chiefly under consideration, but essential to the taxonomy of the group. In our joint paper Dr. Gregory and I referred to this species, as a paratype, a second nearly complete but badly preserved skull and lower jaws. Space prohibited thorough discussion of the peculiarities of this individual and no explanation of its reference to the same species as the type, of rather different aspect, was given.

The two skulls agree in the following chief particulars: (1) the general shape of brain case and interorbital region is the same; (2) the snout is narrow and elongated; (3) the known features of the lambdoid crest, glenoid and ear regions are the same; (4) so far as known in both, the dental formula is the same; (5) the morphology of the teeth is the same so far as known; (6) the measurements of the teeth are the same so far as accurately obtainable. The paratype (No. 21704) differs from the type (No. 21708) in the following principal particulars: (1) Both cranial and facial regions are shorter, the facial relatively more so; (2) the orbit is larger relative to the skull; (3) the snout is less elongate, the diastemata shorter; (4) the jaw is more slender; (5) the lateral incisor may be smaller, but this is uncertain.

In weighing these resemblances and differences it will at once be seen that the resemblances are those upon which valid taxonomic conclusions are usually based, while the differences are without exception just such as are often seen between the young and the adult of the same species. It is true that the material is imperfect and that further discoveries may indicate specific separation, but this seems improbable. It is a sounder practice to refer specimens to the same species when they cannot be proven to be distinct on the basis of known homologous parts than to create separate species for them because they cannot be rigidly proven to be the same.

EVIDENCE OF THE DENTITION.—Gregory and Simpson provisionally considered the *Zalambdalestidae* as ancestral to zalambdodont insectivores, although clearly stating that the paracone and metacone are more separate and more buccal than in any undoubted zalambdodonts and that the skull is almost devoid of the peculiarly zalambdodont specializations. We considered the separation of the two phyla represented by the Cretaceous families to be slight and emphasized (p. 14) the many resemblances of the *Zalambdalestidae* to the *Leptictidae*, suggesting that the zalambdodont and leptictid groups were possibly not yet distinct. Largely on the basis of a much improved knowledge of the details of molar structure, it now seems more probable that the zalambdodont and leptictid lines were distinct at this time and that *Zalambdalestes* stands closer to the latter, while the true zalambdodonts were derived from a group closer to the *Deltatheridiidae*.

Most of the characters of *Zalambdalestes* fall into four different categories: (1) primitive characters; (2) points of special resemblance to the zalambdodonts; (3) points of special resemblance to the leptictids; (4) specializations peculiar to the genus or family. The main conclusion here drawn is that the third of these categories is more indicative of true affinities than the second.

The anterior part of the dentition is the most highly specialized. The long diastemata and the enlarged lateral upper and median lower incisors are specializations of definitely insectivore character but not leading to any one group of later Insectivora, indeed excluding this genus from direct ancestry of any known later form. The relatively small two-rooted upper and incisiform lower canines are possibly primitive, but they do resemble those of some zalambdodonts (cf. *Limnogale*, *Microgale*, *Potamogale*) although not very closely. The absence of P_1^1 points in the same direction, although this again is a specialization so common and so readily acquired as to afford no really good evidence. These teeth are absent in all zalambdodonts and are also absent in the *Erinaceinae*, but are present in the *Gymnurinae* and in the *Leptictidae*, save *Acmeodon*. P^2 is a small tooth of purely primitive character.

$P^{3,4}$ are becoming molariform. Each has a protocone, parastyle and meta-style, but a single undivided cusp represents both paracone and metacone. The closest analogy, although not exact, is seen in *Potamogale*, but here we begin to encounter difficulties in the comparison with undoubted zalambdodonts, for in the very ancient and primitive *Palaeoryctes* (cf. also *Limnogale*) P^3 is definitely more primitive and the chief cusp of P^4 is more central, as in *Potamogale*. In all other zalambdodonts this cusp is almost or quite internal. P^3 of the Cretaceous genus is also more molariform than in *Leptictis*, but the conditions in this Oligocene form may be secondary for the earlier forms of the same family approach *Zalambdalestes* as closely as does *Potamogale*. P^4 in the leptictids always has the paracone and metacone distinct so far as known, but the conditions in the much older *Zalambdalestes* could readily give rise to those in the leptictids.

The crucial evidence of the molars continues this confusing resemblance to two groups now widely separate, but points much more definitely toward the erinaceomorphs. The molars are short and wide, and in badly worn teeth, such

as the only ones available when the joint paper was written, the resemblance to zalambdodonts is impelling. The structure revealed in *Zalambdalestes grangeri*, however, changes this. It is impossible to consider these teeth as structurally similar to those of such genera as *Ericulus*, *Centetes*, *Solenodon*, or *Chrysochloris*, before the upgrowth of the internal cingulum. Not only would this oppose the view, so strongly supported by comparative anatomy, embryology, and paleontology, that this cingulum is vestigial, not rudimentary,¹ but it is strongly contradicted by the actual morphology of the teeth in question. With their two large buccal cusps and strong cingulum external to these, the teeth of *Zalambdalestes* are obviously closer to those of *Palaeoryctes* or of *Potamogale* than to any other zalambdodonts. But even here the morphological gap is large, for in these two genera the paracone and metacone are median and nearly confluent and the external shelf is wide, with strong styles, while in the Cretaceous genus paracone and metacone are quite distinct and buccal, while the external shelf is represented only by a strong but narrow cingulum and the styles are vestigial.

On the other hand, the molars of *Zalambdalestes* are almost identical with those of the leptictids in ground plan. They differ only in being shorter, more transverse, without hypocone or anterior cingulum. The absence of these two features of the later leptictid molars is primitive and the more transverse development, not in any event a fundamental difference, is approached by such leptictids as *Palaeolestes* and *Gypsonictops*. The molars of *Zalambdalestes grangeri* are longer than those of *Z. lechei*, furthermore, and the differences from the leptictidae are really slight. The small M^3 also resembles the homologous tooth in leptictids closely and is quite unlike that of any true zalambdodont.

The lower cheek teeth confirm the evidence of the uppers. P_3-4 are strikingly leptictid in general character, P_4 being quite as molariform as in many leptictids. Nor does any character of the lower molars exclude them from the structural ancestry of the latter. The only approach to zalambdodont structure lies in the short trigonids, but this is not very distinctive, is simply complementary to the short upper molars, and is not, as invariably in zalambdodonts, accompanied by a shortening of the heels. *Palaeoryctes* and *Potamogale* are the most primitive zalambdodonts in this respect, as in other dental characters, but in neither is the heel structure like that of *Zalambdalestes* and in both the high trigonid towering above the small, low heel is quite unlike the condition seen in *Zalambdalestes* and in the Leptictidae.

OSTEOLOGICAL EVIDENCE.—Turning to the skull and jaws, the evidence tends in the same direction as that of the dentition. The resemblances to the Zalambdodonta are largely those in which this group most

¹This problem is much too large to discuss here. Valuable discussions with references to the most important literature will be found in the following studies:

Gregory, W. K. 1922. The Origin and Evolution of the Human Dentition. Baltimore. Esp. p. 101-107.

Leche, W. 1907. Zur Entwicklungsgeschichte des Zahnsystems der Säugetiere, etc. 2ter Teil, 2ter Heft: die Familien der Centetidae, Solenodontidae, und Chrysochloridae. Chun's Zoologica, XLIX. (This work contains a great wealth of information on zalambdodonts and to it and to Leche's other papers on Insectivora the writer is deeply indebted.)

Matthew, W. D. 1913. A Zalambdodont Insectivore from the Basal Eocene. Bul. A. M. N. H., XXXII, 307-14. (Full description of *Palaeoryctes*, to which reference is frequently made in the present paper.)

approaches the primitive conditions for all insectivores. The basicranial structure is poorly known but, as already pointed out by Gregory and

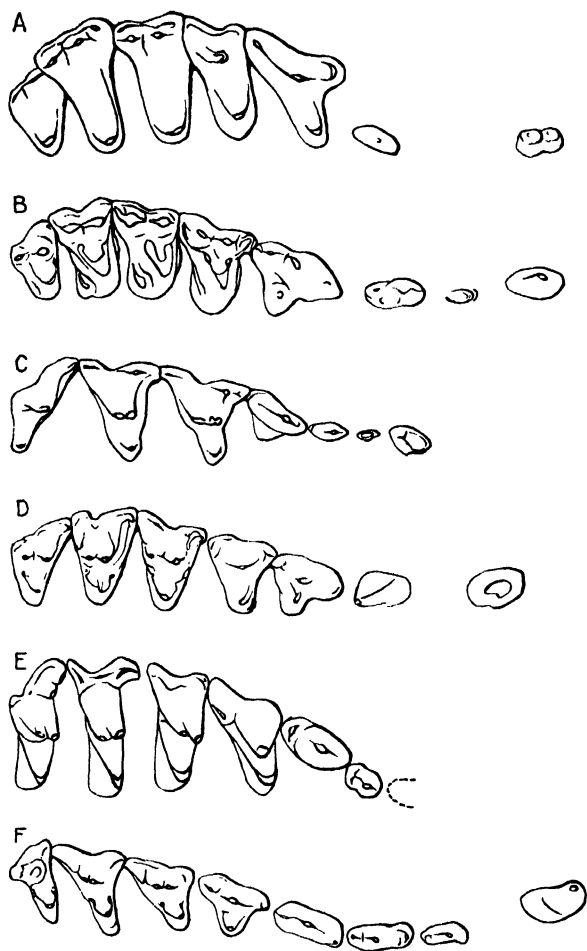


Fig. 1. Comparative diagrams of right upper cheek. A, *Zalambdalestes grangeri*. B, *Diacodon bicuspis*. C, *Dellatheridium pretrituberculare*. D, *Didelphodus absarokae*. E, *Palaeoryctes puercensis*. F, *Sinopa strenua*. Not to scale. Drawn by John Germann.

Simpson, is devoid of characteristically zalambdodont characters so far as can be determined. The complete zygomata and unfused nasals are, of course, primitive, but the loss of these characters was a very early and universal specialization of zalambdodonts. The general

aspect of the skull is somewhat like some zalambdodonts (although the postorbital constriction is slight or lacking in the matter) but is equally, or rather more, like some leptictids (cf. *Diacodon*, for example) and really furnishes no convincing evidence of affinities beyond strongly confirming reference to the Insectivora.¹

The posterior region of the lower jaw with its hook-like, non-inflexed angle and long slender coronoid also is a slight modification of a type occurring in most groups of insectivores. The femur is more like that of *Ictops* than of any known zalambdodont, but is too generalized to cast much light on the problem.

The pelvis also is primitive in general features, suggesting the basic type seen with many variations in the Insectivora and retained in modified form in many other primitive placentals. The resemblance of this pelvis to that of some creodonts, such as *Trilemnodon*, is marked, but in the latter forms the crista lateralis is generally more ventral and the ventrolateral surface of the ilium reduced. The pelvis is not exactly like that of any other known insectivore. The probable participation of the pubis in the acetabulum rim and the median crista lateralis distinguish it from that of any soricid or talpid and the strong development of the gluteus medius area differs sharply from any zalambdodont. The position of crista lateralis, of the spina anterior inferior ilii, and of the tuberculum iliopectineum are all paralleled in the leptictids and the expanded anterosuperior plate of the ilium and its outward extension anteriorly are largely due to greater emphasis of characters also occurring in less extreme form in erinaceomorphs. The fact that this modification is very like that seen in some creodonts is interesting but is probably not indicative of special affinity.

Deltatheridiidae

The characteristic members of this family are *Deltatheridium* and *Deltatheroides*, two closely related genera which differ chiefly in that in the former P^1 is lacking, P^2 is one rooted, P^3 is shorter than P^4 , and P^4 has only a slight basal internal heel, while in the latter P^1 is present, P^2 two-rooted, P^3 as long as P^4 , and P^4 has a distinct internal heel. Unfortunately *Deltatheroides*, in some respects the more interesting, is less adequately known, but its general structure was probably close to that of the other genus. *Hyotheridium* was referred to the family doubtfully; it is sharply distinct in its slender elongate snout, and the cheek tooth structure is very little known so that its true relationships are open to question.

Gregory and Simpson considered this family as structurally "in a very central position, ancestral to the creodonts and to many or all

¹The reference of the Zalambdalestidae to the Insectivora does not rest largely on primitive characters, as in so many supposed Eocene insectivores or as in the Deltatheridiidae, but on numerous positive resemblances to undoubted insectivores. It hardly appears necessary to debate this point, but Pfeffer, in a recent study (Pfeffer, G. 1927. Die Frage d. Grentbestimmung zwischen Kreide und Tertiär in zoogeographischen Betrachtung. Jena), denies that they are even placentals, suggesting that they are an extinct group of stragglers from the Pantotheria. Without wishing to slight Dr. Pfeffer's elaborate and valuable summaries of much other material, the main thesis of his paper may be said to be that the placentals suddenly came into being at the beginning of the Tertiary, which is supposed to be chiefly delimited by this event. Rather than recognizing that the Mongolian mammals put the last nail in the coffin of this theory, moribund for fifty years, and on no evidence save that they refute his arguments, Pfeffer gives these mammals a position absolutely opposed by every feature of their anatomy.

of the dilambdodont insectivores and possibly also to other orders." Reconsideration enlarges and strengthens the main points of this view and adds the suggestion that divergence from the zalambdodonts is really less in this family than in the Zalambdalestidae.

RELATIONSHIP TO DIDELPHODUS.—It was also suggested that *Didelphodus*, of the American lower Eocene, might belong to this family. *Didelphodus* differs from *Deltatheroides* in the absence of P^1 , from *Deltatheridium* in the larger 2-rooted P^2 and submolariform P^4 , and from both Cretaceous genera in the heeled P^3 and more distinct paracone and metacone of the molars. Except for these points, which indicate merely that *Didelphodus* is more advanced than either of the earlier genera, the upper teeth are very closely similar. The lower teeth of *Deltatheroides* are unknown. *Didelphodus* differs from *Deltatheridium* in the lower dentition by the presence of P_1 , the stouter and more complex P_{3-4} , the slightly wider molar heels, the shorter trigonid on M_1 , the smaller paraconids, and the shorter heel on M_3 . The absence of P_1 and long heel of M_3 are certainly specializations in *Deltatheridium* and they exclude it from the direct ancestry of *Didelphodus*, although not profound differences. The heel is narrow in both, although more so in the Cretaceous form, and it is impossible to say which is the more primitive condition. The same is true of the relative sizes of paraconids and metaconids. The genera appear to be related, although showing incipient specialization along slightly divergent lines. *Deltatheroides* has no known character excluding it from the ancestry of *Didelphodus*, but is insufficiently known for a positive conclusion on this point.

The reference of *Didelphodus* to the Deltatheridiidae seems warranted by the facts in hand and is convenient. It has been referred to the Leptictidae, both as a creodont and as an insectivore, and also to the Proviverridae, but its resemblances are not at all close to either family.¹ *Phenacops*, from the middle Eocene, is apparently related to *Didelphodus*.² It is known only from an imperfect lower jaw, but is

¹Despite its name, *Didelphodus* has nothing to do with the marsupials. On this genus see especially:

Cope, E. D. 1881. The Temporary Dentition of a New Creodont. *Am. Nat.*, XV, 667-9. (Here referred to *Deltatherium*.)

" . . . 1882. Notes on Eocene Mammalia. *Am. Nat.* XVI, 522.

" . . . 1885. Tertiary Vertebrata. *Rept. U. S. Geol. Surv. Ter. (Hayden)*, III, 284.

Matthew, W. D. 1918. Insectivora, etc., in Matthew & Granger, A Revision of the Lower Eocene Wasatch and Wind River Faunas. *Bul. A. M. N. H.*, XXXVIII, 579-85.

Scott, W. B. 1892. A Revision of the North American Creodonta, etc. *Proc. Ac. Nat. Sci. Phila.*, 1892, 311.

²Matthew, W. D. 1909. The Carnivora and Insectivora of the Bridger Basin. *Mem. A. M. N. H.*, IX, 535-6.

" . . . 1918, loc. cit., p. 582.

interesting as having P_1 reduced and the heel of M_3 very narrow and long—convergences toward *Deltatheridium*.

Aside from these two Eocene genera, there appear to be no other mammals which show special affinity with the Deltatheridiidae and none with which generic comparison is necessary.

RELATIONSHIP TO ZALAMBODONTS AND CREODONTS.—Turning to the broader aspects of the problem, *Deltatheridium*, *Deltatheroides*, probably *Hyotheridium*, and apparently also *Didelphodus* and *Phenacops* form a group of distinct genera which may be provisionally united into a single family. The characters of this family suggest closer comparison especially with zalambdodont insectivores and with creodonts, two ancient and primitive groups widely divergent in their more specialized members.

Matthew (1913, loc. cit.) was the first to point out the resemblances between the molars of *Didelphodus* and those of the zalambdodonts and to suggest that this genus, which he referred to the Leptictidae but which then occupied a position apart from any other known form, might afford a clue to the origin of the peculiar teeth of this division of the Insectivora.

Structurally, the family Deltatheridiidae does offer an almost ideal point of departure for the zalambdodonts. The molars are not unlike those of *Potamogale*, still closer to those of *Palaeoryctes*. The high trigonids and low narrow talonids are as typical of the ancestral zalambdodont condition as of the more central carnivores. The premolars are less specialized than in any known zalambdodont and could give rise to the conditions in the latter. The upper molars with their wide external shelves and central, almost connate paracone and metacone are also closer to those of *Palaeoryctes* than are those of any other known mammal not definitely a zalambdodont. There are no specializations sufficiently profound to exclude the family, as a broad unit, from a position very close to the ancestry of the zalambdodonts.

Nevertheless there is reason to believe that the known members are advancing more in the direction of the Carnivora. Their departure from a primitive, very central position is slight but seems to indicate that their phylum lay closer to the creodont line than to any other arising at this time. The canines are much enlarged and single-rooted, the molars do not tend to shorten but seem to be approaching such types as *Proviverra*, *Deltatherium*, and others, the talonids are

narrow but are not short and that of M_3 is unusually long—a specialization independent from the similar one which appears in some later carnivores but nevertheless of creodont type and directly opposed to the tendencies which gave rise to the zalambdodonts. It is conceivable that *Hyotheridium* is closer to the zalambdodonts than are the typical genera, but too little is known of it. The creodont and zalambdodont lines may tentatively be visualized as diverging at a time somewhat earlier than that of the Djadokhta Formation and the Deltatheridiidae as arising in or near the base of a focal Asiatic proto-creodont group, within the order Insectivora.

BROADER RELATIONSHIPS

These relationships, while inevitably subject to radical revision when other discoveries make advances possible, do rest on resemblances of a definite sort. Beyond them are other broader and less definite but not less important inferences which may be stated without too much insistence. The structure of the deltatheridiids agrees with their position in time between the pre-placental, pre-marsupial pantotheres and the close but distinct array of placental orders in the early Tertiary and with their position in space near the center of the land masses later dominated by placentals in suggesting that they, of all known mammals, stand closest to the common point of divergence of many or all placental mammals. In the skull and dentition they come very near to showing all the features which the most competent students of Paleocene and early Tertiary mammals have believed would characterize such a central group when found.

Of the important characters of the family as a whole, only one is unexpected or could be considered as widely aberrant, namely, the great width of the shelf external to the paracone and metacone, but this feature also, while possibly more highly developed in this particular line than in some others then diverging from the insectivorous proto-placentals, is apparently to be considered as primitive.

Winge, in an early and important paper on molar evolution, long ago suggested that the external styles and cingulum of the upper molar are extremely ancient structures.¹ For his extreme view that they are the *most* ancient part of the tooth there seems no real evidence and a vast body of facts now opposes it, but more and more items of evidence, of which these Cretaceous mammals are not the least, are

¹Winge, H. 1882. Om Pattedyrenes Tandskifte, etc. Vidensk. Meddel. f.d. naturh. Foren. i Kjöbenhavn, 1882, p. 15-69.

appearing to demand a greater antiquity and importance for the part of the upper molar external to the paracone and metacone than has been commonly granted. In the most primitive living mammals and in the majority of the early Tertiary forms the upper molars usually have a strong external shelf, in some cases, which may offer a real clue to the whole process, agreeing with the *Deltatheridiidae* in occupying nearly half the total width. Not only is such a structure seen in ancient and primitive *zalambdodonts*, but also relatively little modified in many *creodonts*, which are the most primitive and central members of a group including carnivores and ungulates and related to the ancestry of other orders. The *soricoids* and bats also have a specialized molar structure which could be derived from that of the *Deltatheridiidae* by wider separation of paracone and metacone, their acquisition of a *lambdoid* shape, and the upgrowth of a *hypocone*. In the more primitive members of many groups of mammals the paracone and metacone are not really external and there appears to be no real evidence that in these groups they have migrated inward from a strictly buccal position.

It is not to be assumed that no new styles have arisen, or that all which occupy analogous positions are homologous. It is suggested only that the ancestral condition, the condition in the Cretaceous insectivores which gave rise to all higher mammals, was near that of the *Deltatheridiidae*, with a large bifid central cusp, an internal heel, and a more or less broad external cingulum or shelf. These are probably the only elements which were present in the common ancestry and which are strictly homologous (when correctly identified, of course) throughout all placentals. Within each line of descent the teeth went their own way, *hypocones* (not really homologous in the different orders), *conules*, *styles*, supplementary cusps arose or were lost, paracone and metacone became more distinct (most mammals) or fused (*zalambdodonts* and some carnivores), premolars became molarized by steps which followed the general history of the molars but, since they started from a different basis, could not be expected to recapitulate the exact history. But enough has been said on this very complex subject, to which the writer hopes to return in more detail, to indicate its probable bearing on the immediate question.

CONCLUSIONS

1. The *Zalambdalestidae* and *Deltatheridiidae* are not widely different but are related to diverging groups.

2. The *Zalambdalestidae* are the more specialized and, contrary to the opinion first expressed, are more distant from the *zalambdodonts* than are the members of the other family

3. The closest affinities of the *Zalambdalestidae* are with the *erinaceomorphs*, of which group they represent a very early and non-ancestral branch.

4. The *Deltatheridiidae* are on a very primitive plane and show but little specialization from a condition structurally ancestral to the majority of placental mammals.

5. Such specialization as they do show is tending in the *creodont* direction and they strongly suggest the hitherto hypothetical group of Cretaceous insectivores inferred, especially by Matthew, to be the immediate ancestors of the *Carnivora*.

6. The evidence further suggests that the *zalambdodont* insectivores had their origin very near this group, although probably not specifically in the family *Deltatheridiidae*.

7. Both *Zalambdalestidae* and *Deltatheridiidae*, although on a very low evolutionary level, are definitely placentals and *Insectivora* and a break still remains between them and the Jurassic *pantotheres*, a break which is not profound and which can now be filled by inference more surely than before but which is not actually bridged by any known mammals.

56.9,2 (1181:51.7)

PALEOCENE MULTITUBERCULATES FROM
MONGOLIA¹BY W. D. MATTHEW, WALTER GRANGER, AND
GEORGE GAYLORD SIMPSON

In 1925 Matthew and Granger² described as *Prionessus lucifer* the lower jaw, without teeth, of a small multituberculate. This specimen, collected in 1923, is from the Gashato Formation which was referred to the Paleocene—a reference rendered still more probable by later discoveries. In 1925 further collections were made, including the specimens of multituberculates here described.

***Prionessus lucifer* Matthew and Granger, 1925**

New material of this species consists of a lower jaw with broken M_1 and complete but worn M_2 (A. M. No. 21710), a palate with all of the molars (A. M. No. 21717), and some isolated teeth and fragments (A. M. No. 21724). As is generally the case in the later multituberculates, M_1 is narrower and longer than M_2 . The tooth is too worn and broken for an accurate count, but the cusp number was relatively small, possibly about five outer and four inner cusps. M_2 is subtriangular, with three outer and two inner cusps, giving the formula 3:2. The cusps are large, rather quadrate, relatively simple. The two posterior cusps of the outer row are imperfectly separated at their bases.

In the upper jaw there is a single premolar root immediately anterior to M^1 . The specimen is broken anterior to this point, but the reduction of the single lower premolar suggests a similar condition in the upper jaw, as in *Tanialabis* ("Polymastodon"). The cusp formula of M^1 appears to be 6:7:5. Outer and middle rows are of approximately the same length, but the latter has the greater width. The inner row narrows and becomes ridge-like anteriorly and does not quite reach the anterior end of the tooth. The cusps are simple, with no definite indication of the secondary furrows and ridges characteristic of most American Cretaceous and Paleocene multituberculates, although these may have been removed by wear. M^2 is about as wide and long, and like the opposing lower tooth is subtriangular, but with the shortest

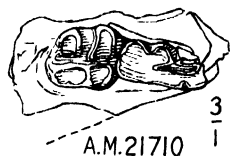


Fig. 1. *Prionessus lucifer* Matthew and Granger. Part of right lower jaw with M_1 -2, A. M. No. 21710. Crown view, three times natural size.

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 86.

²Amer. Mus. Novitates, No. 189.

cuspid-row external. The external row is represented by a single cusp, rounded externally, concave on its inner or median surface. From its apex a ridge passes anterointernally to form a cusp-like wall at the anterior end of the mid-row. Posterior to this, in this row, are two large cusps. The inner row consists of three large nearly conical cusps. The formula may be written 1:3:3, although the anteromedian cusp is obscure.

The palate itself is crushed, but some character can be made out. The posterior (palatine?) portion is pierced by several irregular foramina, but there do not appear to be any true palatal vacuities between the molars or posterior premolars.¹

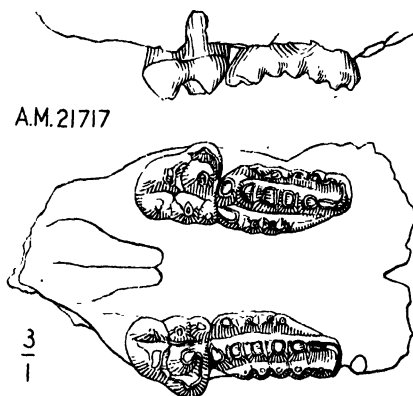


Fig. 2. *Prionessus lucifer* Matthew and Granger. Part of skull with all molars, A. M. No. 21717. Palatal and partial right lateral views, three times natural size.

The choanæ are rather narrow and extend forward to a point about opposite the middle of M^2 . The anterior root of the zygoma appears to have been just anterior to M^1 , which, on comparison with *Ptilodus* and *Tæniolabis*, agrees with the other indications of an abbreviated ante-molar region in *Prionessus*.

***Sphenopsalis*² *nobilis*, new genus and species**

TYPE.—A. M. No. 21736, an isolated left M^2 . Collected in 1925.

HORIZON AND LOCALITY.—Gashato Formation at Shabarakh Usu, Mongolia.

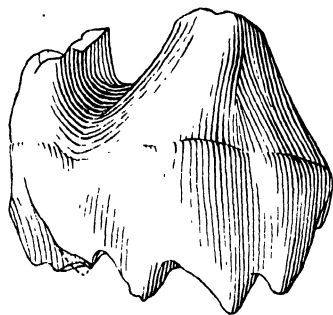
DIAGNOSIS.—Cusp formula of M^2 1:2:4. This tooth nearly as large as in *Tæniolabis taöensis*, width 11.0 mm., length about 14 mm. Single outer cusp an antero-internal-posteroexternal crest, almost wholly anterior to the outer part of the antero-median cusp. The latter developed as a large, oblique, curved crest beginning at the midpoint of the anterior border and rising to an apex near the midpoint of the external border. Immediately posterior to this, another cusp nearly parallel to it and of similar character but slightly smaller and more transverse. The inner

¹Vacuities are present in *Ptilodus*. Broom reported them in *Tæniolabis*, but restudy suggests that they are absent in this genus.

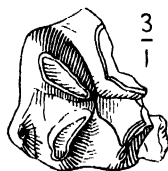
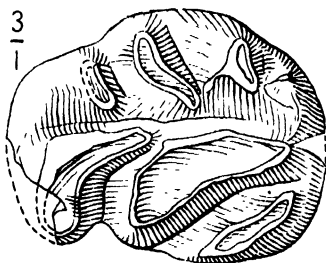
²σφην, wedge, ψαλις, scissors, in allusion to the cuneiform shearing cusps and suggestive of its ally *Catopsalis*.

cuspid row consisting of four cusps, the second and third the longest, their bases united internally, apices along the internal margin, the posterior three somewhat produced into crests which run anteroexternally.

In addition to the type, there are several fragments of teeth apparently of this genus. One (A. M. No. 21715) is the anterior end of a first lower molar, perhaps of the left side. It indicates a width for this tooth of seven or eight millimeters. The cusps are in two rows and are simple, without secondary ridging or grooving, and like those of M^2 are produced into oblique crests, those of the external row

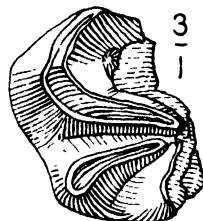


A. M. 21736



A. M. 21715

Fig. 4. *Sphenopsalis nobilis* Matthew, Granger, and Simpson. Anterior end of M_1 , A. M. No. 21715. Crown view, three times natural size.



A. M. 21713

Fig. 5. *Sphenopsalis nobilis* Matthew, Granger, and Simpson. Anterior end of left M_2 , A. M. No. 21713. Crown view, three times natural size.

Fig. 3. *Sphenopsalis nobilis* Matthew, Granger, and Simpson, new genus and species. Type, left M^2 , A. M. No. 21736. Internal and crown views, three times natural size.

running posterointernally, those of the internal row posteroexternally. Anterior to one of the rows (probably the external, if analogies are not misleading) is a small thorn-like accessory cusp. From its small size it is not certain that this tooth belongs in this species—it is slightly narrower relative to M^2 than is M_1 of *Tæniolabis*—but the structure is harmonious, and the size difference not unduly great.

Among other fragments is the anterior end of a left M_2 which, from its character and perfect occlusion with the type, surely belongs to this species. The anterointernal cusp is large, high, very strongly and perfectly crescentic, the wings of the crescents pointing backwards. The outer row is only about half as wide as this cusp. The anteroexternal cusp and part of that following are preserved. The former, at least, was like the cusps of the M_1 described above, with an external

apex and a sharp crest running posterointernally. The total width anteriorly is 10.6 mm.—exactly the same as in some specimens of *Tæniolabis taënsis*.

The dentition, so far as revealed, is certainly multituberculate but of an adaptive type very different from that of any other known genus. The high, narrow, sharp crests of the cusps are little fitted for heavy crushing or grinding but form a cutting device of remarkable perfection, probably an adaptation to some specific type of vegetable food.

AFFINITIES OF *PRIONESSUS* AND *SPHENOPSALIS*

Matthew and Granger (Op. cit., 1925, p. 6-7) compared *Prionessus* with *Catopsalis*, *Meniscoëssus*, and *Tæniolabis* rather than with the *Ptilodus* group, which it more resembles in size, and suggested that it might be "an ancestral type of the catopsaline subfamily." The present more complete data are still inadequate for final decision, but they tend to support this view. The large, stout lower incisor¹ (not strongly compressed as in *Eucosmodon*), the absence of P_3 and the greatly reduced P_4 , the simple cusps and their number (close to *Catopsalis* in at least the lower jaw), the probably short broad muzzle, and the absence of palatal vacuities (which we believe also to have been absent in *Tæniolabis*) all suggest relationship to this group rather than to the true Ptilodontidæ. The difference in size is striking but, as regards family relationships, unimportant.

Sphenopsalis is as yet morphologically unique and this, with the inadequacy of the known material, makes its relationships still more doubtful. It also, however, may tentatively be considered as related to *Catopsalis* and *Tæniolabis* more closely than to other previously known genera. The adaptative type is very different from that of *Tæniolabis*, with its broad crushing teeth², but *Catopsalis* is somewhat intermediate in adaptation. The molars of *Tæniolabis* have many points in common with those of *Sphenopsalis* so far as the latter are known. In the American form the cusps have apparently become heavier and more quadrate, in the Mongolian more compressed and crested, but it is a tenable hypothesis that these represent divergent adaptations from a more or less intermediate ancestral type, perhaps more nearly preserved in the Mongolian *Prionessus* and, probably to less extent, in the American *Catopsalis*.

¹Known only from its alveolus.

²Less different, however, than would be supposed from the literature, for the unworn molar cusps of *Tæniolabis* are high, crested, and rather slender.

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DESCRIPTIONS OF NEW BIRDS FROM EASTERN ECUADOR AND EASTERN PERU

By FRANK M. CHAPMAN

Most of the new birds herein described are contained in collections received from eastern Ecuador and eastern Peru since the publication of my Bulletin¹ on the distribution of bird-life in Ecuador.

***Crypturus macconnelli fumosus*, new subspecies**

SUBSPECIFIC CHARACTERS.—Closely resembles *Crypturus macconnelli macconnelli* Brabourne and Chubb of British Guiana, but slightly darker throughout, the upperparts, particularly, being more saturated chestnut-drab rather than fuscous of Ridgway; cinnamon-brown markings of the lower tail-coverts darker and much more restricted, the brown tips of the longer coverts 3 mm. instead of 10 mm. wide and sometimes almost obsolete; in this respect more nearly resembling *Crypturus berlepschi* Rothschild of the Colombian-Pacific Fauna but general color not so dark as in that species, the crown and nape auburn instead of black, as in *berlepschi*; shafts of feathers of throat and cheeks conspicuously white.

TYPE.—No. 254,824, Amer. Mus. Nat. Hist.; ♂, testes enlarged; Junction Rios Napo and Curaray; October 19, 1925; Olalla and Sons.

SPECIMENS EXAMINED

Crypturus macconnelli fumosus.—ECUADOR: Napo and Curaray, 3 ♂, 2 ♀; Rio Suno, 3 ♂, 1 ♀. PERU: Mouth Rio Orosa, right bank of Amazon, 2 ♂, 1 ♀.

Crypturus macconnelli macconnelli.—BRITISH GUIANA, 2 (topotypes).

Crypturus berlepschi.—COLOMBIA: Barbaças, Nóvita, Baudo, 3.

The receipt of two specimens of true *macconnelli* from the British Museum permits of direct comparison with the eastern Ecuador bird (of which we have acquired additional specimens since I referred Rio Suno birds to *macconnelli*) revealing the differences mentioned above. The characters of the proposed new form confirm my belief that *berlepschi* of the Colombian-Pacific Fauna is the Pacific coast representative of the group.

Otus usta (SCLATER) A VALID FORM, WITH NOTES ON ECUADORIAN SCREECH OWLS

Otus usta (Sclater) (1862, Trans. Zoöl. Soc., IV, p. 265, Pl. LXI; Ega [=Teffé] Solimões) has long been considered a synonym of *Otus*

¹1926, Bull. Amer. Mus. Nat. Hist., LV.

watsoni Cassin (1852, Journ. Acad. N. S. Phila., II, p. 95, Pl. xii, fig. 1).¹ The receipt, however, of specimens from both sides of the Amazon shows the existence of two forms, one from the north, the other from the south side of this river.

Since Cassin's description of *watsoni* mentioned no locality, comparison with his type was required to determine to which of the two forms represented by our series of twenty-three specimens the name *watsoni* was applicable. A type without locality can never be duplicated and should not, in my opinion, be exposed to the risks of transportation. I, therefore, sent examples of both forms from our series to Dr. Witmer Stone at the Academy of Natural Sciences asking him to compare them with Cassin's birds. As a result of this comparison Dr. Stone writes: "There are two specimens marked by Cassin as '*watsoni*' which I take to be the two that he described. One is badly faded from exposure to light, but there is no question that they are both referable to the same form as these you have labelled *watsoni watsoni*."² Furthermore, one of them has an old tag on one leg reading 'Orenoque' which Cassin overlooked or did not think important enough to mention. This indicates that the birds are the northern form."

As Dr. Hellmayr (*loc. cit.*) records specimens in the Tring Museum from Suapure, Venezuela, near the junction of Rio Caura with the Orinoco, we may, I assume, in view of the information given by Dr. Stone, accept the Orinoco as the type region for *Otus watsoni watsoni*, and I therefore withdraw the suggestion made in my work on Ecuadorian birds that the Napo region be considered the type-locality.

As a species *watsoni* may be known by its usually blackish, unstreaked upperparts, irregularly barred and finely freckled with ochraceous, these markings being usually less numerous on the crown. The ear-tufts measure from 35-40 mm. in length, are black usually with ochraceous markings on the inner webs. The outer vanes of the outer scapulars and, in about one-third of our series, of the outer median wing-coverts are ochraceous. The black shafts below are as heavy as in *choliba*. Three of our specimens are in the ruddy plumage of the rufescent phase.

In *watsoni watsoni*, the more northern form, the ground color of the underparts is ochraceous tawny; the white markings are absent or comparatively restricted, and the black bars average fewer and broader. In the form from south of the Amazon the ground color of the underparts averages paler, the white markings are more extensive (present in all of

¹Berlepsch, 1901, Bull. B. O. C., XII, p. 10; Hellmayr, 1907, Nov. Zool., XIV, p. 407; Chapman, 1917, Bull. Amer. Mus. Nat. Hist., XXXVI, p. 253; 1926, LV, p. 246.

²Specimens from eastern Ecuador.

our six specimens) extending from breast to, or even on, lower tail-coverts, and the black markings are finer and more numerous giving a vermiculated appearance wholly absent, or less highly developed in *watsoni watsoni*. For this southern form it is probable that we may use the name *Otus watsoni usta* (Sclater) described from Ega, Brazil, on the south shore of the Amazon. While it is true I have seen no specimens from Ega, the comparative stability of the species warrants this proceeding pending the receipt of topotypical specimens. It should be said, however, that Sclater's plate suggests *watsoni watsoni* rather than the bird for which I accept the name *usta*.

***Otus choliba crucigerus* (Spix)**

This species has not before been represented in our collections from Ecuador. We now have a specimen from the mouth of the Curaray. The occurrence also at this point of *Otus watsoni* establishes a faunal association which, as Dr. Hellmayr has already said, demonstrates the specific distinctness of *choliba* and *watsoni*.

Our collections show that not only two but three species of *Otus* inhabit the Tropical Zone of eastern Ecuador. The third appears to represent *Otus guatemalæ* and I propose for it the name *Otus guatemalæ napensis*.

***Otus guatemalæ napensis*, new subspecies**

CHARACTERS.—Not strongly streaked with black, either above or below, as in *Otus choliba*: brown phase; general tone of upperparts sepia, the feathers finely vermiculated with black and ochraceous-tawny; ear-tufts like crown; superciliary white; outer scapulars and outer median wing-coverts with large white spots; underparts comparatively uniform; finely barred and vermiculated with sepia and white, with some inconspicuous darker shaft-streaks. Rufous phase; general color hazel or tawny, the markings as in the brown phase. Resembling *O. guatemalæ guatemalæ* (Sharpe) but smaller, the markings throughout generally finer. In size and in the markings of the upperparts more nearly resembling *Otus vermiculatus* Ridgway of Panama and Costa Rica, but underparts more finely and uniformly marked and tarsus fully feathered.

TYPE.—No. 185,228, Amer. Mus. Nat. Hist.; ♀ ad.; below San José de Sumaco, eastern Ecuador; April 19, 1924; Olalla and Sons.

SPECIMENS EXAMINED

Otus guatemalæ napensis.—ECUADOR: San José, 1 ♀; Curaray and Napo, 1 ♂; Macas region, 1; "Napo," 1. ? W. ECUADOR: Cerro Manglar Alto, 1 ♂ im.

Otus guatemalæ guatemalæ.—GUATEMALA, 1. NICARAGUA: ? Jalapa, 3000–4000 ft. alt., 1 ♂, 1 ♀.

Otus vermiculatus.—PANAMA: Santa Fé, alt. 1300 ft., Veraguas, 1 ♂, 1 ♀ (?).

Otus watsoni watsoni.—COLOMBIA: La Morelia, 1 ♂, 1 ♀. ECUADOR: "Napo," 1 ♂, 1 ♀; Río Suno, 2 ♂; Lagarto Cocha, 1 ♀; Curaray and Napo, 2 ♂, 6 ♀. PERU: Puerto Indiana, mouth Napo, 1 ♂, 1 ♀.

Otus watsoni usta.—PERU: Rio Orosa and Amazon, 3 ♂, 2 ♀; "Amazon," 1.

Otus roboratus.—PERU: Perico, Chinchipe, 6 ♂, 4 ♀; Jaen, 2 ♂, 1 ♀.

MEASUREMENTS

			Wing	Tail	Tarsus
<i>Otus g. guatemalæ</i> , Guatemala	?		157	79	29 mm.
" " " Jalapa, Nic.	♂		167	85	31.5
" " " " "	♀		167	80	32
" <i>vermiculatus</i> , Veraguas, Pan.	♂		167	75	26.5
" " " " "	♀		155	75	26
" <i>g. napensis</i> , Curaray, E. Ec.	? ♂		165	75	26
" " " Macas, "	? ♀		160	75	26
" " " "Napo," "	♀		164	75	27
" <i>roboratus</i> , Chinchipe, Peru	3 ♂	165-169	85-89	32.0-34	
" " " " "	3 ♀	165-169	86-90	32	
" <i>watsoni watsoni</i> , Curaray, Ec.	2 ♂	165	79	31	
" " " " "	3 ♀	160-167	78-85	31.5-33	
" " <i>usta</i> , Orosa, Peru	3 ♂	167-171	84	31.0-31.5	
" " " " "	1 ♀	167	84	31	
" <i>choliba crucigerus</i> , Curaray, Ec.	1 ♂	168	91	30	

The known distribution of true *guatemalæ* and the occurrence of the possibly representative *vermiculatus* in Panama may seem to make it improbable that this form from eastern Ecuador is subspecifically related to the Guatemalan race; nevertheless, the differences between our Guatemala and eastern Ecuador birds seem to me to be of not more than subspecific value.

In size and coloration the Panama *vermiculatus* is clearly intermediate between the two, but the absence of feathers from the lower part of the tarsus separates it from both, but does not, in my belief, preclude the possibility of intergradation with them.

In view of the occurrence of a relative of *guatemalæ* in eastern Ecuador we must now revise our estimate of Salvadori and Festa's record of this species from western Ecuador. This has hitherto been referred to *roboratus* Bangs and Noble¹ but it now seems probable that the bird recorded from Vines was of the *guatemalæ* type, possibly the one herein described. A specimen in the barred immature plumage from Cerro Manglar Alto, above Colonche, adds further support to this belief. It has fully feathered tarsi, but is too young to supply dependable color data, but the fact that its fully grown tail measures only 73 mm. while the tail in adult *roboratus* averages 87 mm. and in *guatemalæ napensis* 75 mm. indicates that it is more closely related to the latter than to the

former. I think, therefore, that we may definitely remove *roboratus* from the list of Ecuador's birds and provisionally refer the west coast form to *napensis*.

It may be added, while this material is before me, that the most distinctive character of *roboratus* is a dark, in some specimens nearly black, crown distinctly set off by broad whitish superciliaries reaching from the bill to the nape where they are connected by a similarly colored nuchal band that forms the base of the triangle. There is a tendency in *usta* to develop such a mark, but the ground color of the underparts in *roboratus* is white, quite different from the ochraceous-tawny of *usta*.

Otus roraimæ Salvin¹ is described as similar to *guatemalæ* but smaller. Chubb² considers it inseparable from *crucigera*, but if the measurements are correct (wing, 149 mm.) it is apparently distinct.

***Neomorphus napensis*, new species**

SPECIFIC CHARACTERS.—Resembling *Neomorphus pucherani* Deville of the Rio Ucayali, but prevailing color of the underparts drab-gray or light drab instead of cinnamon-buff, the breast narrowly and faintly, not broadly and strongly margined with black.

TYPE.—No. 255,363, Amer. Mus. Nat. Hist.; ♂ ad.; junction of Rio Curaray with Rio Napo, Ecuador; December 20, 1925; Olalla and Sons.

DESCRIPTION OF TYPE.—Entire crown shining blue-black with greenish reflections anteriorly, the central feathers elongate, forming a pronounced crest; fore back olive-citrine with metallic reflections becoming more bronzy on the lower back, rump, and upper tail-coverts; tail, from above, largely yew-green with bronzy and purplish reflections, the purple areas increasing in extent toward each side and occupying essentially all of the outer pair of feathers; tail, from below, nearly uniform purple-black; wings blue-black with metallic reflections, exposed portions of the inner feathers, chestnut-bay, inner vanes of tertials more purple, the under surface of the wings practically uniform fuscous-black; throat and breast drab-gray, drab laterally, the feathers of the lower throat and breast to the black pectoral band, very narrowly and faintly margined with black; lower parts, posterior to the pectoral band drab, gray laterally; flanks much darker, ventral region and lower tail-coverts smoky, tibia light drab or drab; tarsi and toes mottled horn-color, the margins of the scales paler; in the dried skin bare ocular space reddish, the bill Brazil red, terminal portion of the maxilla light cadmium; end of the mandible greener. Wing, 165; tail, in molt; tarsus, 74; chord of culmen, 57 mm.

SPECIMENS EXAMINED

Neomorphus napensis.—The type.

Neomorphus pucherani.—PERU: Junction Rio Orosa and Amazon nearly opposite the mouth of the Napo, 3 ♂, 3 ♀. BRAZIL: São Paulo at Olivença,³ south shore of the Amazon east of the Javari, 1 ♂, 1 ♀; Hyutanahan,³ north shore Rio Purus, 1 ♀.

¹1897, Bull. B. O. C., VI, p. 38.

²1916, Birds British Guiana, I, p. 288.

³Coll. Carnegie Museum.

It is noteworthy that our collectors secured *Neomorphus salvini æquatorialis* at Lagarto Cocha near the Napo, and less than 200 miles from the type locality of *napensis*, thus proving the occurrence of two species of this genus in the same faunal area.

In describing *Neomorphus pucherani*, Deville had in his possession specimens from "l'Ucayale et l'Amazone." The adult male, on which the name *pucherani* is based, is described as having the "ventre d'un roux canelle sur les côtés, plus pâle, et tournant au blanchâtre sur le milieu"; while a specimen of "jeune âge" is described as having the "ventre blanchâtre." The description of the adult agrees, on the whole, with our specimens from the mouth of the Orosa on the south side of the Amazon and is probably based on an example from the Ucayali. The description of the bird believed to be young agrees with the bird herein described as new, but Deville's specimen lacked even the narrow black margins to the breast feathers shown by my type. It seems probable that Deville's supposed young bird came from the north shore of the Amazon. Comparison of our specimens with the colored plates¹ illustrating the birds described by Deville confirm the view here set forth. That of the adult resembles our specimens from the Orosa, that of "jeune âge" is near our adult male of *napensis*.

It will, of course, require actual comparison to determine the identity of Orosa and Ucayali specimens, but since examples of *lepidophanes* from São Paulo de Olivença on the Amazon and Hyutanahan on the Rio Purus, kindly loaned me by Mr. Todd, agree with our Orosa birds, it seems more than likely that the latter are similar to those from the Ucayali. In this event *lepidophanes* becomes a synonym of *pucherani*. I may add that this opinion is shared by Dr. Hellmayr who, during a recent visit to the Museum, examined our material.

The description in the 'British Museum Catalogue of Birds,' based on two specimens from Pebas, on the north bank of the Amazon, applies to *napensis* and not to *pucherani*, and is thus misleading.

NOTE ON THE PROPER APPLICATION OF THE NAME

Neomorphus rufipennis GRAY

Gray's *Cultrides rufipennis*² was based on a bird "supposed to be a native of Mexico." It was described as having "the throat and lower part of the breast and abdomen ashy white." The figure agreed with this description. Sclater³ subsequently associated Gray's name with the bird

¹1856, Expédition Castelnau, Oiseaux, Pls. VI, VII.

²1849, P. Z. S., p. 63. Pl. x.

³1864, P. Z. S., p. 249.

from British Guiana on the basis of a specimen secured on the lower Demerara River.

When describing *Neomorphus nigrogularis*¹ from the foot of Mt. Duida on the upper Orinoco I had for comparison a male and female from Suapure on the lower Orinoco. They agreed with Gray's description and plate in having the throat and lower part of the breast and abdomen ashy white and under the assumption that they represented *rufipennis* of Gray I named the Duida bird.

Recently we have secured in exchange from the British Museum two specimens from British Guiana which, while fully supporting the existence of two forms, agree with the Duida bird. At first glance, therefore, I concluded that I had named the wrong bird, but reëxamination of Gray's description and plate now confirm my original belief that they were based on the bird with the light gray not dark gray or sooty throat and abdomen. It appears, therefore, that the name *rufipennis* should be applied to the bird of the lower Orinoco, while the form of the upper Orinoco and British Guiana should be known as *nigrogularis*. Possibly their relationships may be best expressed under the name *Neomorphus rufipennis rufipennis* and *Neomorphus rufipennis nigrogularis*.

***Eubucco richardsoni nigriceps*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Eubucco richardsoni richardsoni* (Gray), but head black, very slightly if at all tinged with red; chin-spot black with a barely perceptible tinge of red more evident at the posterior margin; upperparts averaging slightly darker green, red of breast slightly deeper. Female not distinguishable from the female of *richardsoni*.

TYPE.—No. 231,329, Amer. Mus. Nat. Hist.; ♂ ad.; Junction Apiyacu and Amazon, near Pebas, Peru; January 20, 1927; Olalla and Sons.

SPECIMENS EXAMINED

Eubucco richardsoni nigriceps.—PERU: Apiyacu, near Pebas, 8 ♂, 2 ♀.

Eubucco richardsoni richardsoni.—PERU: Pomará, Rio Marañon, 1 ♂, ? Puerto Indiana, mouth of Napo, 1 ♀. ECUADOR: Zamora, 1 ♀; Curaray and Napo, 14 ♂, 11 ♀; Rio Suno, 6 ♂, 3 ♀; San José, 3 ♂, 4 ♀. COLOMBIA: Buena Vista, above Villavicencio, 2 ♂; "Bogota," 1 ♂, 1 ♀.

To the mutational type of variation so prevalent in the genera *Capito* and *Eubucco* we may doubtless attribute the presence of this well-marked race of *Eubucco richardsoni* in the same faunal area as that occupied by true *richardsoni*. A large series from the junction of the Curaray and Napo agrees with specimens from the upper Napo which may be accepted as the type-locality of that race. In our series of twenty-three males

¹1914, Bull. Amer. Mus. Nat. Hist., XXXIII, p. 194.

from eastern Ecuador three closely approach the least typical specimen of *nigriceps*. A female from the mouth of the Napo cannot certainly be referred to either race but a male from Pomará, at the western limit of the humid tropical fauna on the Marañon, is typical *richardsoni*. This appears to be the southern known limit of the species. On the south shore of the Amazon, at Orosa nearly opposite Pebas, it is replaced by *aurantiicollis*, and southward in the Subtropical Zone it is apparently represented by the rare *Eubucco steerei*, of which Watkins secured for us a male at Uscho, alt. 5000 ft., fifty miles east of Chachapoyas, to which region this beautiful species appears to be restricted. *Eubucco steerei*, in turn, is represented by *E. glaucogularis* in the subtropics of central Peru and the latter becomes *versicolor* in southeastern Peru and Bolivia. The whole presents a fascinating series of variations apparently mutational in character. As I have before remarked¹ our material does not support the validity of a race of this species (*granadensis* Selater) from the Bogotá region. It is possible that in Colombian birds the chin-spot may average smaller but it does not seem to be darker than in birds from Ecuador.

***Nonnula ruficapilla rufipectus*, new subspecies**

SUBSPECIFIC CHARACTERS.—Resembling *Nonnula ruficapilla ruficapilla* (Tschudi) of central eastern Peru, but more richly colored, the breast ochraceous-orange rather than ochraceous-buff, this color occupying a greater area on the underparts; upperparts darker, the tail pronouncedly blacker; bill averaging longer (24–26 mm.).

TYPE.—No. 231,489, Amer. Mus. Nat. Hist.; ♂ ad.; Puerto Indiana, near junction Napo and Amazon; June 26, 1926; Olalla and Sons.

SPECIMENS EXAMINED

Nonnula ruficapilla rufipectus.—PERU: Puerto Indiana, Rios Napo and Amazon, 1 ♂, 3 ♀.

Nonnula ruficapilla ruficapilla.—PERU: Tulumayo, Prov. Junin, 2 ♂, 1 ♀, 1 (?).

Nonnula ruficapilla pallida.—BRAZIL: Tapirapoan, Matto Grosso, 2 ♂, 1 ♀.

A strongly marked form which extends the recorded range of *Nonnula ruficapilla* to the north bank of the Amazon.

***Pithys albifrons brevibarba*, new subspecies**

SUBSPECIFIC CHARACTERS.—Most nearly related to *Pithys albifrons peruviana* Taczanowski, but white feathers of the chin and throat shorter, the black area between their tips and the chestnut breast correspondingly wider, its feathers, as a rule, less elongated; white feathers of the crown averaging shorter and encroaching less on the center of the forehead; size slightly smaller. 5 ♂, wing, 69–70; tail, 37–38 mm. 5 ♂, Rio Seco, Peru, wing, 71–73; tail, 39–41 mm.

¹1926, Bull. Amer. Mus. Nat. Hist., I.V, p. 343.

TYPE.—No. 184,496, Amer. Mus. Nat. Hist.; ♂ ad.; Lower Rio Suno, eastern Ecuador; March 8, 1926; Olalla and Sons.

SPECIMENS EXAMINED

Pithys albifrons brevisbarba.—ECUADOR: Rio Suno, 3 ♂ (March); Rio Curaray, 1 ♂ (Oct.); "Napo," 8. COLOMBIA: Rio Guatequia, near Villavicencio, 1.

Pithys albifrons peruviana.—PERU: Rio Seco, east of Chachapoyas, 6 ♂, 2 ♀, 1 ? (July).

Pithys albifrons albifrons.—BRITISH GUIANA: 18; Cayenne, 2; VENEZUELA: Suapure, Lower Orinoco, 3 ♀; Duida, 3 ♂, 2 ♀ (Jan., March, Aug., Sept., Oct.). BRAZIL: Obidos, Lower Amazon, 2 (Feb.)

The receipt of Peruvian specimens shows that birds from that country are nearer to true *albifrons* than are specimens from the intervening region in Ecuador and Colombia. Our series indicates that in the latter the white plumes of crown and throat are less developed than at either extremity of the bird's range. This variation might be considered as seasonal, but so far as our material goes there appears to be no difference with season in the development of the white head feathers.

Rhegmatorhina brunneiceps, new species

SPECIFIC CHARACTERS.—Similar to *Rhegmatorhina melanosticta* (Selater and Salvin) but crown light ochraceous-tawny, instead of dingy smoke-gray; black supra-orbital feathers longer, less erect and grading in structure and color into the feathers of the crown.

TYPE.—No. 261,888, Amer. Mus. Nat. Hist.; ♂ ad.; Rio Seco, alt. 3000 ft., about 30 miles west of Moyobamba, northern Peru; July 16, 1925; H. Watkins.

DESCRIPTION OF MALE.—Forehead to base of culmen and sides of maxilla, center of crown and nape light ochraceous-tawny, the feathers increasing in length toward the occiput where about 17 mm. long their barbs not connected; tips of nuchal feathers dusky; bare circumorbital region entirely surrounded by black feathers; the supraorbital feathers ochraceous-tawny basally, this color increasing, the black, apical portion decreasing toward the center of the crown; anteorbital and supra-orbital feathers much stiffened, the former erect, a recumbent position gradually being assumed supraorbitally; back argus-brown, tail blackish chestnut, nearly black terminally; wings externally brighter, more rufescent than the back, internally ochraceous-tawny; cheeks and ear-coverts black spreading slightly to the throat, remaining underparts clear Brussels-brown; feet blackish; maxilla blackish, lighter apically; mandible light horn-color, darker basally.

DESCRIPTION OF FEMALE.—Similar to the male but center of crown and the throat with slightly more black, the back and wing-coverts with conspicuous black spots margined with argus-brown.

SPECIMENS EXAMINED

(See Measurements)

MEASUREMENTS

			Wing	Tail	Tarsus	Culmen
<i>Gymnopathys r. rufigula</i> , Kamakusa, B. G.	♂		74.5	46	25.5	20.5 mm.
" " Potaro River, "	♂		78	48	25.5	20
<i>Rhegmatorhina gymnops</i> , Rio Jamauchim,						
Brazil	♂		75	49	28	20
" <i>hoffmannsi</i> , Calama, Brazil	♂		78	49	28	20
" " " "	♀		77	49	28	21
" <i>melanosticta</i> , Rio Suno, Ec.	♂		79	52	28	...
" " Lagarto Cocha,						
Ec.	♀		74.5	49	28.5	22.3
" " La Pampa, S.E.						
Peru	♂		78	50	30	20
" <i>brunneiceps</i> , Rio Seco,						
N. Peru	♂		80	52	28.5	21
" " Rio Seco,						
N. Peru	♂		84	55	28	20
" " Rio Seco,						
N. Peru	♀		82	51	29	19.5
" " Rio Seco,						
N. Peru	♀		79	54	28	20.5

This well-marked species is separated from its only near ally by both the color of the crown and structure of the supraorbital feathers. In *melanosticta* these feathers are short, erect, face outward and form a distinct ruff wholly separated from the feathers of the crown. In *brunneiceps* they are longer, more recumbent, and grow in the same plane as the feathers of the crown into which they gradually merge both in form and color. While distinct from *brunneiceps*, it is apparently representative of *melanosticta*, and as the latter is found both to the north and south of the former it is probable that the range of *brunneiceps* is restricted to a limited area in which it has found isolation. It was associated with species characteristic of the Tropical Zone.

I agree with Dr. Hellmayr that *melanosticta* is generically distinct from *Gymnopathys* but, on the other hand, I do not feel that it is generically separable from *Rhegmatorhina*. Together with the bird here described, *melanosticta* differs from *Gymnopathys* and agrees with *Rhegmatorhina* in its large bare orbital region, in possessing a crest, while in the barring of the upperparts both species resemble *Rhegmatorhina hoffmannsi*. Furthermore, these two birds are found associated with *Gymnopathys* but not with other species of *Rhegmatorhina* and they thus appear to represent this genus west of the Madeira.

It is true, as Dr. Hellmayr states, that in both the shape of the crest and the structure of the feathers composing it, *melanosticta* differs from *Rhegmatorhina*, and its singular orbital ruff further separates it from that genus. If the latter character were as well developed in *brunneiceps* the two combined might afford grounds for proposing a new genus. But in the form of the supraorbital *brunneiceps* seems intermediate between *melanosticta* and *Gymnopathys rufigula*, this being the only character in which it shows closer relation to that genus than to *Rhegmatorhina*. Separation from the latter genus would therefore have to be based almost wholly on the characters of the crest and these do not seem to me to be of sufficient importance to warrant this step.

ANACHILUS, new genus

GENERIC DIAGNOSIS.—In general size and color resembling *Automolus rubiginosus rubiginosus* Scater, but structurally more nearly related to *Anabazenops fuscus* (Vieillot), the bill, however, agreeing in shape with that of *Megaxenops purnaguar* Reiser.

DESCRIPTION OF GENUS.—A large furnariine bird of the subfamily Philydorinae; culmen straight, except at the extreme tip which is slightly decurved, the gonys strongly recurved; nostrils circular, non-operculate; wings well developed, rather pointed, fourth primary (from without) longest, third and fifth subequal and but slightly shorter, second equal to the sixth, the first (outer) 20.5 mm. shorter than the second; rectrices twelve, subacute terminally, where slightly stiffened, the outer pair 20 mm., the second pair 7 mm. shorter than the longest, the remainder subequal; feet robust, toes and their claws well developed, claw of hind toe longer than toe itself.

TYPE.—*Anachilus ucayalæ* Chapman.

***Anachilus ucayalæ*, new species**

SPECIFIC CHARACTERS.—In general size and color resembling *Automolus rubiginosus rubiginosus* but with the bill as in *Megaxenops* and with the general proportions of *Anabazenops*.

TYPE.—No. 261,892, Amer. Mus. Nat. Hist.; ♂ ad.; Lagarto, upper Rio Ucayali, Peru; March 26, 1928; Olalla Bros.

DESCRIPTION OF TYPE.—Upperparts auburn, the crown a shade darker, light shaft streaks showing faintly on the forehead; rump and upper tail-coverts chestnut-tail bay; wing-quills fuscous, externally auburn, internally between ochraceous-orange and ochraceous-tawny; a narrow superciliary and sides of the throat Sanford's brown; lores grayish white; auriculars Sanford's brown margined with the color of the crown; underparts, bend of the wing and under wing-coverts amber-brown; tibiae and lower tail-coverts chestnut-bay; feet bluish black; maxilla brownish; mandible horn-color. Length (skin), 210; wing, 106.5; tail, 84.5; tarsus, 27; hind-toe without claw, 16; claw, 11; middle-toe with claw, 28; outer toe with claw, 22; inner toe with claw, 19.5; culmen, 25; depth of bill at nostril, 8 mm.

This species, of which we have only a single specimen, is one of the most novel of the many new birds that the Olallas have secured for us. Its combinations of characters add a striking type to the family Furnariidæ. In its large size and rich, ruddy coloration it resembles *Automolus rubiginosus rubiginosus*, while its bill agrees in shape with that of *Xenops*

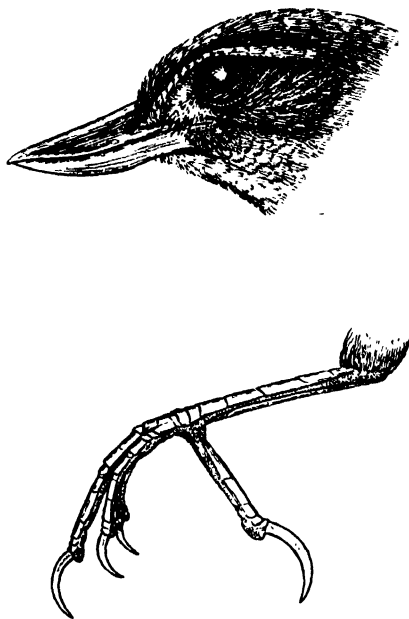


Fig. 1. *Anachilus ucayilæ*. Head and outer side of left foot. Natural size.

and *Megazenops* but these resemblances apparently express parallelism of development rather than close relationship. The new bird's real relationships appear to be with *Anabazenops*, with which it agrees in proportions and structure of tail, wings and feet; while its bill is a further development of the type toward which *Anabazenops*, in its nearly straight maxilla and slightly upturned mandible, points the way.

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HIND LIMB MUSCULATURE AND HABITS OF A PALEOCENE MULTITUBERCULATE

BY GEORGE GAYLORD SIMPSON AND HERBERT OLIVER ELFTMAN

INTRODUCTION

The Order Multituberculata is a great group first appearing in the Triassic and ranging through the Jurassic, Cretaceous, and Paleocene into the base of the true Eocene. Highly characteristic of the Mesozoic and Paleocene wherever mammals are found, it was very widespread throughout at least the best known phases of its history. The most various opinions as to the affinities of the Order have been expressed. A recapitulation of this complex taxonomic history does not enter into the present discussion—it suffices to say that the view to which we subscribe and which we believe most in accordance with the additional data here published is that fully expressed by one of us elsewhere (Simpson 1928; see also Granger 1915, Matthew 1928, Granger & Simpson, in press). According to this opinion, the multituberculates represent an entirely extinct, quite separate mammalian side line, not ancestral to any later forms and related to other mammals only through an ultimate common ancestry in the Triassic or earlier. Despite the fact that the multituberculates thus appear to have little direct bearing on the phylogeny of Tertiary and recent mammals, this exceptionally long-lived and once dominant group is perhaps of even greater morphological interest because of its evolutionary isolation. Within the limits of the now available material, it offers an almost unparalleled occasion for the testing and application of the recently developed methods of reconstituting the anatomy, movements, and adaptations of an extinct group of animals.

This problem was first approached in a previous paper (Simpson 1926) in which the food habits, particularly, were studied on the basis of dental, cranial, and mandibular characters. The present paper is chiefly devoted to a second phase of the same subject, to the attempted reconstruction of the more essential elements of hind limb musculature and to an analysis of this musculature and of the osteology from a functional point of view. The material upon which this is

based is largely a single specimen of nearly complete hind limbs and pelvis from the oldest Paleocene (Puerco) of the San Juan Basin in northwestern New Mexico. This unique and invaluable specimen (Amer. Mus. No. 16325) was found by Walter Granger in 1913 and briefly referred to by him in an abstract published in 1915. A complete morphological description is being given elsewhere (Granger and Simpson, in press).

This hind limb is referred to the genus *Eucosmodon* with much probability. Coming from the oldest known Paleocene horizon, its bearing on the habits of the Jurassic, or, still more, of the Triassic multituberculates is dubious as no skeletal remains certainly referable to the latter forms are yet known. There is, however, reason to believe that conclusions based on the *Eucosmodon* hind limb are applicable in a general way to all members of its family, the Ptilodontidae of the Cretaceous, Paleocene, and lowest Eocene. Various limb fragments are known from the upper Cretaceous, others are known in a different species of *Eucosmodon* from the Torrejon (in this case associated with lower jaws), and parts of the pelvis, femur, tibia and fibula of *Ptilodus gracilis* from the Fort Union of Montana have been described (Gidley 1909). All of this material agrees rather closely with the present more perfect specimen in general functional characters.

In restoring the musculature, accurate restored models, three times natural linear dimensions, were made of the whole pelvis and of the right femur, tibia and fibula. These were mounted in a natural standing pose and the muscles were then fashioned in red modeling clay and affixed in the inferred original positions. Constant reference was made to the original bones, on which the chief muscle attachments are clearly visible, to numerous dissections of recent mammals by Elftman, to the large literature on recent myology, especially of the marsupials and monotremes, and also to the small but important literature on paleomyology (especially Gregory, Camp, Romer, etc.). The completed restoration was then studied, drawn, and dissected as if it had been a recent mammal.

LIMB POSTURE AND MOVEMENTS

The mechanical effect of the limb musculature depends in large part on the normal posture of the various bony elements. This posture is to be inferred chiefly from the osteology itself, the relative sizes of the different segments, the morphology of the individual bones

and, especially, the shape and extent of each articular surface. As all of these surfaces are preserved in the specimen here especially studied, the limb posture is known with a reasonable degree of certainty and serves as a point of departure for a functional analysis of the musculature. The femur had unusual freedom of motion in all directions, but in the normal standing position of the animal it was nearly horizontal, inclined forward, outward, and slightly downward. The angle between the femur and tibia could never have exceeded 90° in life and was usually considerably less—the leg could not be straightened and the crus was usually drawn well backward and could be made almost parallel with the upper limb. Normally the tibia and fibula would thus be directed backward, inward, and downward. The foot, as clearly shown in its almost completely known osteology, is unusually primitive. It is pentadactyl and plantigrade, of grasping type with partially opposable hallux. The digits are strong, the functional length formula $3 > 4 = 2 > 5 = 1$. The terminal phalanges carried claws of moderate size, somewhat compressed transversely.

The foot was clearly a rather flexible structure capable of much movement in all usual ways. The motion of the crus, aside from possible relatively slight rotation, was chiefly simple flexion and extension. The most complex and important movements are those of the femur. These movements are of two quite distinct sorts: rotation of the femur in all directions about a fixed point, the head, and rotation about a linear axis—a line through the center of the head and the middle of the distal end. Further analysis shows that all possible movements of the femur may be resolved into six components, as follows:

- A. Rotation about head of femur:
 - a. Horizontal components (protraction):
 - 1. Forward—protraction of limb.
 - 2. Backward—protraction of body.
 - b. Vertical components (levation):
 - 3. Upward—levation of limb.
 - 4. Downward—levation of body.
- B. Rotation about linear axis:
 - 5. Counterclockwise as viewed from distal end of right femur—positive rotation.
 - 6. Clockwise as viewed from distal end of right femur—negative rotation.

In considering a single limb during ordinary straightforward locomotion two effects alternate: (1) the distal end of the femur

moves forward relative to the pelvis, and (2) the pelvis then moves forward relative to the distal end of the femur. It is clear that these effects are purely relative and that the resultant motion, involving as it does some lateral motion of the pelvis relative to the substratum,

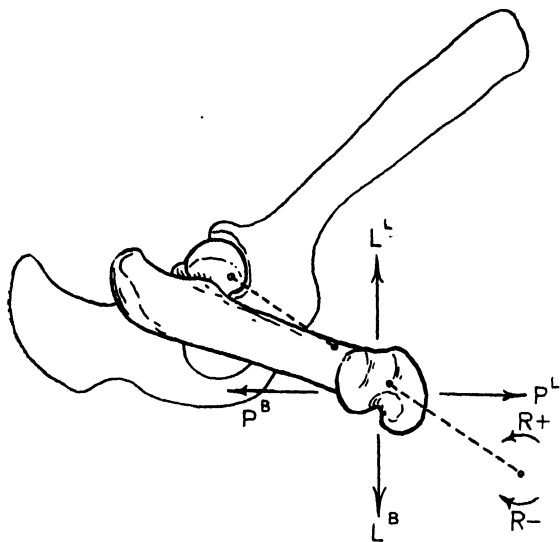


Fig. 1. *Eucoosmodon*. Diagrammatic lateral view of right femur and pelvis, showing normal position and components of femoral motion. Not to scale. LB, levation of body. LL, levation of limb. PB, protraction of body. PL, protraction of limb. R+, positive rotation. R-, negative rotation.

is actually rather more complex. The pelvis, and hence the body, is furthermore moving forward at a nearly constant rate, as protraction of the limb against the body on one side is simultaneous with protraction of the body against the other limb. Each of these two phases of the motion of a single limb involves three of the six components of femoral movement:

First Phase:
Protraction of limb.
Levation of limb.
Positive rotation.

Second Phase:
Protraction of body.
Levation of body.
Negative rotation.

As will appear in the subsequent functional classification of the individual muscles, the majority of the muscles are involved in more than one of the six components. In most cases, however, a given

muscle is involved in only one of the two groups above, that is, in only one of the two phases of the normal stride. Exceptions are seen in the femoro-coccygeus, which is a protractor of the body but also a levator of the limb, and in the obturator externus, which is a protractor and levator of the body but also a positive rotator.

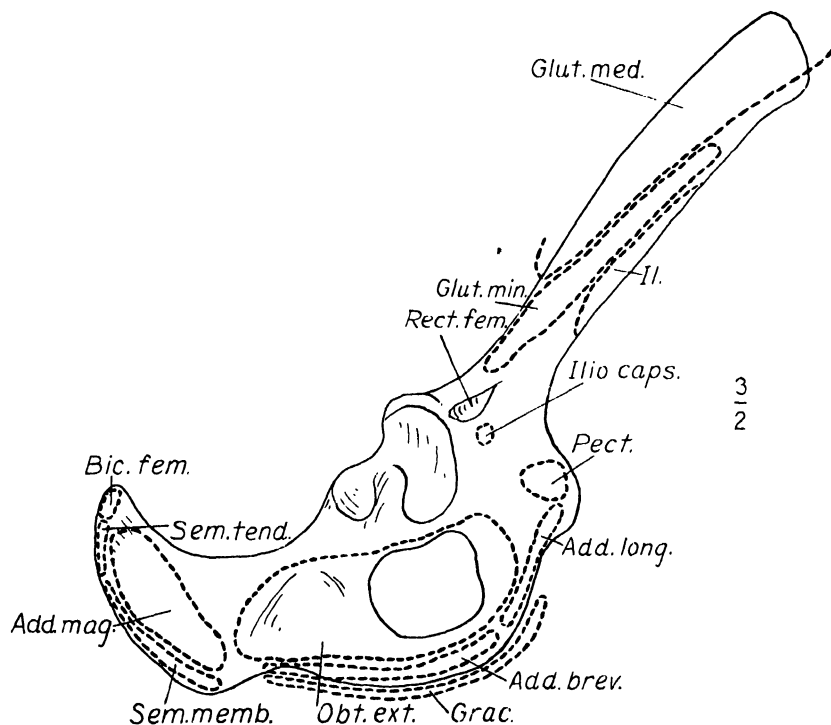


Fig. 2. *Eucosmodon*. Right lateral view of restored pelvis, showing hypothetical areas of muscle attachment. For abbreviations see page 19.

The terms "protractors of limb or body" and "levators of limb or body" seem to us preferable for use in functional analysis to the anatomical terms "flexors," "extensors," "adductors" and "abductors" which consider the body as if it were suspended in space (or laid out on the dissecting table).

Rotation of the femur about a linear axis is unusually important in *Eucosmodon*. The muscles bringing about this rotation are powerful and their origins, courses, and insertions are such as to make their action more effective than it is in most mammals. As brought out

below, the lesser trochanter serves almost wholly for the insertion of positive rotators and is strongly developed and specialized in such a way as to give strong leverage for this motion. The greater trochanter, chiefly for insertion of the glutei, is analogously developed for negative rotation. It results from the nearly horizontal femur and the acute angle between thigh and crus that positive rotation of the femur,

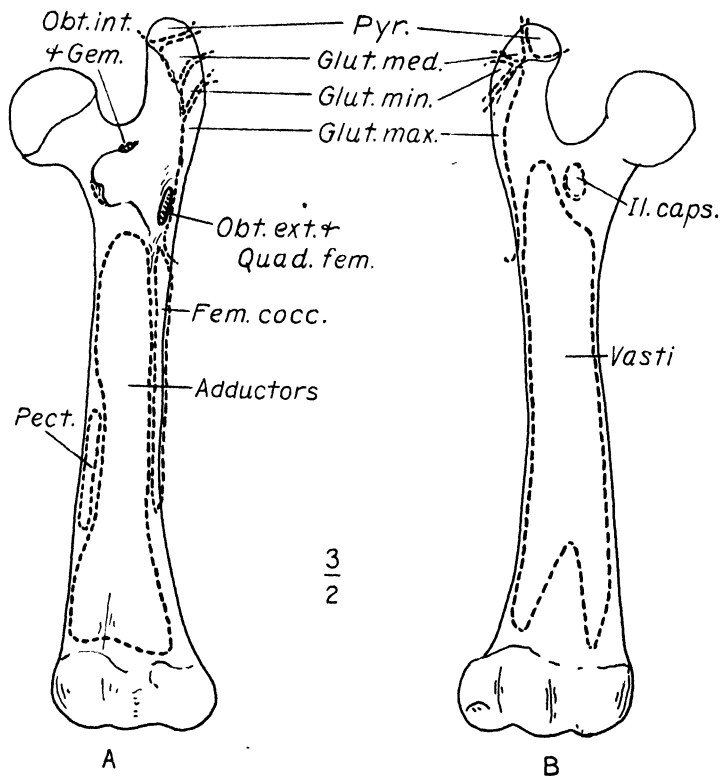


Fig. 3. *Eucosmodon*. Right femur, showing hypothetical areas of muscle attachment. A, ventral view. B, dorsal view. For abbreviations see page 19.

without other simultaneous movements, would cause movement of the foot forward and somewhat inward. Negative rotation, with the foot planted on the ground, would result in moving the body forward and slightly away from this foot.

The position of the femur together with this strong adaptation for rotation distinguishes *Eucosmodon* rather sharply from most other

mammals and from most reptiles. In the majority of mammals the distal end of the femur was drawn more anteromedially beneath the body and rotation, while often present, is generally much more limited than in *Eucosmodon*. An essential difference between *Eucosmodon* and most other mammals is that the muscles which are primarily protractors in the former become involved also in levation in the

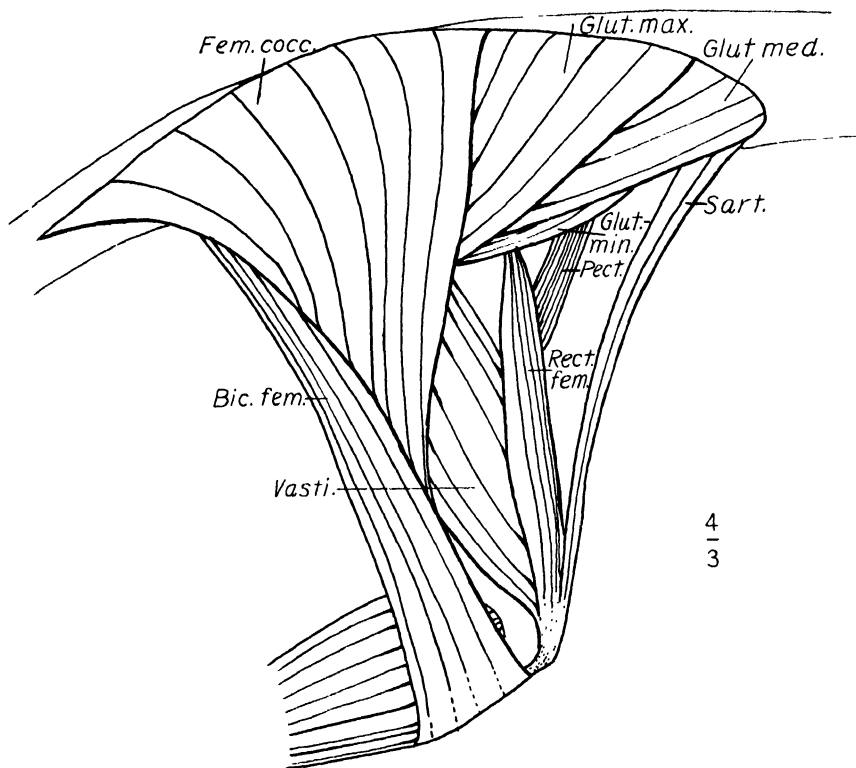


Fig. 4. *Eucosmodon*. Hypothetical restoration of muscles of right hind limb. Superficial dorsal view. For abbreviations see page 19.

latter, due to the changed position of the femur. The disadvantages of retaining a somewhat more reptilian posture were compensated in *Eucosmodon* to a considerable degree by the freedom of rotation.

The actual movements of the animal, whether in the simplest case of normal straightforward locomotion or in its more irregular activities, such as turning or moving backward or laterally, would

obviously each involve a complex combination of the muscular activities here analyzed into their simplest components. The limb was no doubt occasionally used also for purposes other than locomotion (scratching, seizing objects, etc.) but the chief movements involved would be the same except for being related to the pelvis as a fixed point.

MUSCULATURE

TOPOGRAPHY.—Detailed verbal descriptions of the individual muscles are unnecessary. All of the muscles which have been restored and their inferred attachments on the pelvis and femur are seen in the accompanying figures. The following table presents a résumé of the probable conditions:

NAME	ORIGIN	INSERTION
Rectus femoris	Small pit anterior to acetabulum.	With vasti on tibia.
Sartorius	Probably anterior tip of ilium. ¹	With vasti and rectus on tibia.
Biceps femoris.	Ischial tuberosity.	Proximal portion of lower limb.
Iliacus.	Inferior border of ilium.	With psoas major.
Psoas major.	Lumbar vertebrae.	Lesser trochanter.
Psoas minor.	Lumbar vertebrae.	Pectineal process.
Pectineus.	Pectineal process.	Ventral surface of femur.
Femoro-coccygeus.	Fascia lata.	Distal continuation of gluteal crest.
Gluteus maximus.	Fascia lata and upper border of anterior end of ilium.	Gluteal crest.
Gluteus medius.	Dorsal portion of lateral surface of ilium.	Greater trochanter.
Gluteus minimus.	On lateral face of ilium between gluteus medius and iliacus.	Greater trochanter.
Ilio-capsularis ²	Depression below origin of rectus femoris.	Tuberosity on dorsal face of femur at base of neck.
Obturator internus.	Internal surface of pubis and ischium around obturator foramen.	Upper digital fossa.
Gemelli.	Dorsal border of ischium.	Upper digital fossa.
Obturator externus.	Outer surface of pubis and ischium around obturator foramen.	Fossa lateral to lesser trochanter.
Quadratus femoris.	Dorsal border of ischium.	Probably in fossa lateral to lesser trochanter.

¹The origin of the sartorius is in doubt, but there is no evidence that it originated from the pectineal process as does the supposedly homologous muscle in *Ornithorhynchus*.

²Ilio-capsularis = scansorius or ilio-femoralis of authors.

NAME	ORIGIN	INSERTION
Gracilis.	Along pubo-ischiatic symphysis.	Tibia.
Semi-membranosus.	Posteroventral border of ischium below semi-tendinosus.	Tibia.
Semi-tendinosus.	Posterior border of ischium below biceps femoris.	Tibia.
Adductor magnus.	Broad depression on posterior part of lateral surface of ischium.	Ventral surface of femur.
Adductor brevis.	Lateral surface of ischium and pubis near inferior border.	Ventral surface of femur.
Adductor longus.	Anterior part of lateral surface of pubis.	Ventral surface of femur.
Pyriformis.	Caudal vertebrae.	Tip of greater tro- chanter.

FUNCTIONAL CLASSIFICATION

In the following table the muscles are placed in different categories according to their functions in producing the various components of femoral and body movement discussed in a preceding section. The probable relative importance of each muscle in producing the given effect is indicated by the type, the most important muscles for each category being in capitals, those of somewhat less importance in italics, and the least important in roman lower case.

PROTRACTORS

OF LIMB	OF BODY
<i>Rectus femoris</i>	Biceps femoris
Sartorius	Femoro-coccygeus
Iliacus	<i>Gluteus medius</i>
Psoas major	<i>Gluteus minimus</i>
PECTINEUS	Obturator internus
ADDUCTOR LONGUS	Gemelli
	<i>Obturator externus</i>
	<i>Quadratus femoris</i>
	Semi-membranosus
	Semi-tendinosus
	ADDUCTOR MAGNUS

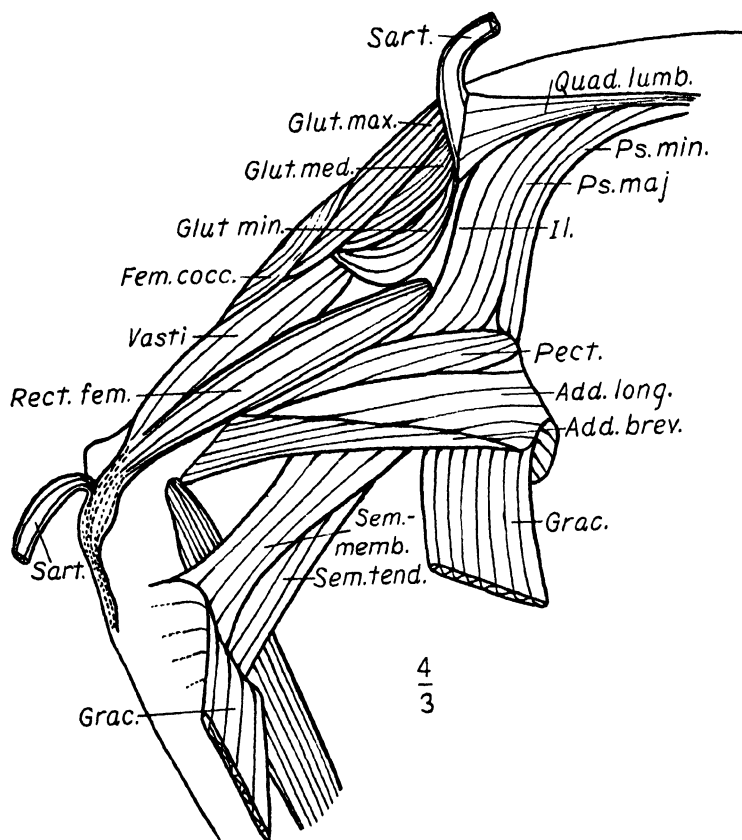


Fig. 6. *Eucosmodon*. Hypothetical restoration of muscles of right hind limb. Anterolateral view. For abbreviations see page 19.

protractor and its development is correlated with the relative mechanical disadvantage of its short lever arm in this animal.

The acetabulum is large and it was closely applied to the almost spherical femoral head, indicating great freedom of action at this joint. The anterior part of the articular surface is large and overhanging, while the posterosuperior border is weak and emarginate. This, too, is related to the large sacroiliac angle and more horizontal femur, the maximum stress being more nearly parallel to the iliac axis than in mammals with small sacro-iliac angles and more vertical femora.

GREATER TROCHANTER.—The muscles inserting on the greater trochanter, glutei medius and minimus and pyriformis, cause the femur to function as a lever of the third order in protracting and levating the body, the distal end of the femur being the fulcrum. In general, as the trochanter becomes longer the speed of action (that is, the amount of body movement caused by a given muscular contraction) of these muscles becomes less and their effective power becomes greater. As the trochanter shortens, the speed becomes greater but the power becomes less until, if the head of the trochanter is in line with the axis of the head of the femur, these muscles will have no power for protraction or levation. In *Eucosmodon* the length of the greater trochanter, which is considerable, must be nearly at an optimum for rapid protraction. When the femur is far forward, at the beginning of the body protractive movement, the chief single protractor, the adductor magnus, is nearly parallel to the femur and hence weak in action. The muscles inserting on the greater trochanter here serve efficiently in starting protraction rapidly, while the adductor magnus would finish it powerfully. The impression is that of a capacity for darting movements or for sudden leaps to safety when startled. The strength of the trochanter and the insertions of the glutei along its extended lateral border also make these muscles effective in negative rotation.

LESSER TROCHANTER.—The usual and, in all probability, the primitive position of the lesser trochanter is near the anterior border of the femur, a position in which the iliopsoas would have little or no rotatory effect. In *Eucosmodon* the great size and strength of the lesser trochanter and its strongly lateral position would make this muscle mass a powerful positive rotator. The smooth and rounded head of the trochanter is apparently due to the fact that in this position the broad obturator externus must pass over it.

DIGITAL FOSSA.—One of the most unusual features of the *Eucosmodon* femur is the apparent division of the digital or intertrochanteric fossa into two smaller fosae, one high up between the neck of the femur and the greater trochanter, and one considerably lower, between the lesser trochanter and the gluteal crest. After many comparisons and after trials of the effects of the muscles with various insertions, we believe that the lower fossa lodged the insertions of the obturator externus and probably also of the quadratus femoris, while the gemelli and obturator internus were inserted into the upper fossa. Comparison with *Didelphis*, for example, shows that the relative positions of these

insertions are not greatly different save for their separation into two groups. This separation seems to be related to, possibly to depend on, the buttressing of the powerful lesser trochanter, from which a ridge curves upward toward the greater trochanter. In other mammals a somewhat similar but generally weaker buttress may be present, but it passes below the whole group of intertrochanteric insertions. The beginning of these divergent developments probably lay in a stage when the lesser trochanter was anterior in position and these various muscle insertions were widely spread on the proximo-ventral surface of the femur, as they are in the monotremes and in the known Jurassic mammalian femora.

FUNCTIONAL ADAPTATION

Broader paleobiological conclusions must involve the correlation of these new data with what is known as to habits and habitat from other sources. This latter evidence has already been given in a general way (Simpson 1926) but it remains to sum up this evidence in the light of continued research and in respect to the specific problem of *Eucosmodon*.

DENTITION.—Evidence as to food habits is derived chiefly from the dentition as correlated with cranial and mandibular osteology and myology. The multituberculates generally are somewhat rodent-like in habitus, although with very numerous detailed differences due to their widely distinct heritage. One pair of incisors in each jaw is enlarged and the molars are of grinding and crushing type, broad, low-crowned, generally with numerous tubercles. The premolars, in most cases, are chiefly adapted to powerful shearing. In addition, the anterior upper premolars, when present, are of use in grasping food and pressing it against the shearing apparatus. The general jaw functions are thus three: (1) the selection and obtaining of food by the incisors, with the mandible in its extreme anterior position; (2) the preliminary comminution of food or removal of undesirable husks, etc., by the posterior premolars, the mandible in its posterior position, the motion chiefly vertical; and (3) the grinding of this food and its preparation for deglutition by the molars, the mandible moving chiefly anteroposteriorly. All of the dental features and of the adaptations of skull and jaws show that the food was certainly largely vegetable.

Turning to *Eucosmodon* in particular, it shares with the other pilodontids a very powerful shearing apparatus, provision for holding the food firmly while it was being cut, and very complex but low

crowned molars. The outstanding individual peculiarity of the genus is the fact that the lower incisors¹ had very long crowns with the enamel limited to an anterior band. Wear was much as in rodents, the softer dentine being worn away rapidly leaving a continuously sharp protruding edge of enamel. There are several marked differences from the usual rodent type, however. The lower incisors are strongly compressed transversely; the tip is rounded, although sharp, and not transverse or chisel-like. Growth was not continuous, roots being formed in the adult, although the incisors did move forward in the jaw following wear, as they do in rodents. Such incisors are markedly different from those of *Ptilodus*, for example, which did not alter in position once fully erupted, had completely enameled crowns, and were not subjected to heavy wear. The *Ptilodus* type of incisor was suitable for picking up small objects for food and for piercing them, but not for gnawing. The *Eucosmodon* type of incisor, on the contrary, has the added function of true gnawing, although less exclusively directed toward this purpose than are the corresponding teeth of rodents.

Comparison with other multituberculates and with the most nearly analogous later mammals thus indicates for *Eucosmodon* a regimen largely herbivorous and including fibrous or woody substances, such as bark or roots, as well as such fruits as were present. Although certainly not predaceous, *Eucosmodon* also gnawed bones when these were accidentally available (see below).

OSTEOLOGY.—Knowledge of the limbs of *Eucosmodon* is largely limited to the posterior appendages considered earlier in this paper. Of the fore limbs nothing is known in the Puercio species and only a few fragments in a smaller species from the later Torrejon. These fragments are sufficient, however, to indicate close similarity to *Ptilodus gracilis*, the fore limbs of which are somewhat better known (Gidley 1909, p. 620). As previously pointed out (Simpson 1926, pp. 247-9), the ratio of femur length to humerus length in *Ptilodus* is 1.33, showing that it was "probably a swiftly moving and agile quadruped." The ratio gives no positive index as to whether the animal was terrestrial or arboreal. The humerus is not that of a fossorial animal.

The structure of the hind foot in *Eucosmodon* indicates great flexibility, grasping power with opposable hallux, and presence of sharp claws. Neither in its proportions nor morphological features does

¹The upper incisors are not yet certainly known.

this hind foot show fossorial or saltatory adaptations. This and other known characters definitely suggest a quadrupedal animal, well adapted for possible arboreal life but also capable of rapid progression on the ground.

ENVIRONMENT.—Multituberculates occurred in a variety of environments. The Mesozoic forms are found in littoral marine deposits (Stonesfield), swamps or freshwater littoral lagoons (Purbeck), marshy flood plains (Morrison), arid uplands (Djadokhta). Distribution of the order was wide not only in time and space but also in facies. As in the case of other orders, such as the Rodentia, the fundamental adaptation was everywhere the same but specific habitats varied widely. Each case would demand some individual consideration.

The genus *Eucosmodon* has been found in several distinct deposits, but these are generally of similar facies. The particular specimen here studied in most detail is from the lower Puerco. Its relation to its environment, like that of any fossil animal, is to be inferred from the following data:

- I. Conditions of deposition of sediments in which found.
- II. Associated Flora—
 - A. As indicative of physical environment.
 - B. As providing a possible specific habitat.
 - C. As providing possible food.
- III. Associated Fauna—
 - A. As indicative of physical environment.
 - B. As including possible enemies.
 - C. As including possible competitors.
 - D. As providing possible food.
- IV. Possible direct traces of activity. (E.g., foot prints, tooth marks, coprolites).

Sinclair and Granger (1914, p. 309) conclude that the Puerco sediments were formed by water, that they were accumulated "on river flood plains or on the surface of broad, low-grade, coalesced alluvial fans," that bogs were locally present, that there was a "heavy growth of vegetation along the streams and, presumably, in the inter-stream areas also," and that there are no indications of aridity. This is also true, broadly at least, of the other formations in which *Eucosmodon* has so far been positively identified and these conditions are clearly those under which *Eucosmodon* lived, although perhaps not the only ones in which various species could exist.

The flora of the Puerco itself is very incompletely known but certainly included fig, bread-fruit, viburnum, plane, and *Paliurus*

(Sinclair and Granger 1914, p. 306). Slight as this list is, it suggests a warm, fairly moist climate and proves that ample facilities for arboreal life were at hand. Even these few species would also provide highly nutritious food. More broadly, the floral facies is similar to that of the Raton and Denver formations, with their large floral lists, and the age, although not quite the same, is not sufficiently different to vitiate analogies. Study of various lists (Knowlton) indicates a probable rich flora at this time and place. Palms, beeches, ivies, laurels, grapes, willows, poplars, oaks, figs, bread-fruits, walnuts—to mention only a few outstanding and probably common types—were surely present in regions inhabited by *Eucosmodon*.

The fauna, as almost always when relatively well known, indicates several different local habitat groups or cenobiotas. There is an aquatic cenobiota: fish, turtles (including *Trionyx*), champsosaurs, crocodiles. A second group includes most of the known mammals: browsing herbivores, omnivorous terrestrial mammals, and predaceous carnivores (with probably some carrion feeders). Fossorial types are absent so far as certainly known, although several mammals, such as the multituberculate *Tæniolabis*, might belong here. Of the known Puerco mammals only *Eucosmodon* is strongly suggestive of arboreal life, although other small tree-living forms were probably present.

Possible enemies are numerous. None of the terrestrial carnivores was too large to scorn *Eucosmodon*, which was as large as a large squirrel or small rabbit, and none was too small to overcome it. In the streams crocodiles and champsosaurs endangered it. Probable close competitors, on the contrary, are quite unknown in this formation. There are no other gnawing animals save *Tæniolabis*, which was much larger, differently adapted, and has not been found at the same level as the pelvis and hind limbs here discussed although it occurs in association with *Eucosmodon* in the upper Puerco. Rodents, which would have been most closely competitive, were quite absent.

It is interesting to note that many of the Puerco bones have been gnawed (Sinclair and Granger 1914, p. 310). Bones are known from each of the two Puerco fossil levels with tooth marks of exactly the size which would be made by known *Eucosmodon* incisors from the respective levels. No other animal is known which could have made these marks and this direct evidence proves that *Eucosmodon*, like many rodents, varied or supplemented its vegetable diet by gnawing bones.

CONCLUSIONS AS TO HABITS AND HABITAT

The individual here chiefly studied lived in a warm, moist, partly forested region, and this was apparently true of all now known members of the genus. It was not aquatic nor fossorial and the direct evidence of the hind limbs, with the indirect evidence of food habits and environment, strongly suggests that it was chiefly arboreal, although no doubt occasionally descending to the ground. Its food was chiefly vegetable and may have included both fruits and more fibrous material, such as bark, supplemented by gnawed bones. It was an agile animal, capable of rapid locomotion, whether on the ground or in the trees where it was clearly safer from enemies and probably more at ease.

RÉSUMÉ

1. The femur of *Eucosmodon* was held in a nearly horizontal position, pointing outward and slightly forward and downward.
2. The restoration of the pelvic musculature shows it to have a degree of differentiation similar to that of other mammals.
3. The details of muscular morphology and function are characteristically different from those of other mammals or of reptiles.
4. The pelvic musculature, in agreement with all other known anatomical and environmental features, indicates an arboreal mode of life.

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ABBREVIATIONS USED IN TEXT-FIGURES

Add. brev.	Adductor brevis
Add. long.	Adductor longus
Add. mag.	Adductor magnus
Bic. fem.	Biceps femoris
Fem. coec.	Femoro-coecygeus
Gem.	Gemelli
Glut. max.	Gluteus maximus
Glut. med.	Gluteus medius
Glut. min.	Gluteus minimus
Grac.	Gracilis
Il.	Iliacus
Ilio- and Pubo-coec.	Ilio- and Pubo-coecygei
Il. caps.	Ilio-capsularis
Isch.-coec.	Ischio-coecygeus
Obt. ext.	Obturator externus
Obt. int.	Obturator internus
Pect.	Pectineus
Ps. maj.	Psoas major
Ps. min.	Psoas minor
Pyr.	Pyramidalis
Quad. fem.	Quadratus femoris
Quad. lumb.	Quadratus lumborum
Rect. fem.	Rectus femoris
Sart.	Sartorius
Sem. memb.	Semi-membranosus
Sem. tend.	Semi-tendinosus
Vasti	Vasti

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NEW NEOTROPICAL *ERAX* IN THE AMERICAN MUSEUM OF NATURAL HISTORY (DIPTERA: ASILIDÆ)

By S. W. BROMLEY

HAITI

The following new species of *Erax* is represented by two specimens, a male and a female, collected in Haiti. Both are in the type collection of The American Museum of Natural History.

Erax pachychæstus, new species

Total length: ♂, 29 mm.; ♀, 33 mm. A large yellowish-gray species with the antennal arista thickened toward the tip. It is closely allied to *Erax stylatus* Fabricius but differs in having the femora reddish instead of black. It is also slightly larger.

MALE.—Mystax, palpal hairs, occipital bristles and bristles of the vertex light yellowish. Facial and occipital pruinosity light yellowish. Two or three black bristles in upper part of mystax and two on the ocellar tubercle. Beard white. Antennæ dark reddish except third segment and arista which are black. Arista long, slightly longer than first three segments, curved and slightly thickened preapically. Proboscis black. Palpi dark reddish with one or two black bristles.

Thorax light grayish-yellow pollinose with a brown median stripe (median area lighter) and brown lateral spots. Pleura, coxæ, and scutellum with light yellowish pile. Fine short hairs on dorsum of thorax black, and a few black bristles, with yellowish bristles intermingled, posteriorly. Legs dark reddish, the tibiæ lightest. Tarsi and tips of tibiæ nearly black. Hairs on legs light yellowish; bristles black. A row of strong bristles on under side of posterior femora. An anterior-dorsal area on the first two femora is dark, nearly black. Scutellum reddish, but covered with a grayish pruinosity which obscures this coloration.

Wings lightly tinged with brown merging to hyaline basally. The costal border is dilated as in *E. stylatus* Fabricius. The stump vein is absent.

Abdomen black with whitish hairs, segments six and seven white pruinose. Genitalia large, elongate, piceous with black hairs.

FEMALE.—Similar, except wings are lighter, the costal border not dilated and the stump vein is present. Ovipositor long, piceous.

Holotype, male, La Morinière, Haiti, March 1-5, 1922, alt. about 125 ft., F.4638. Allotype, female, Pivert, Haiti, April 1, 1922, alt. about 250 ft., F.4657. Both collected by F. E. Watson.

BRAZIL

The following 7 species are all from Brazil and were part of the S. W. Williston Collection now in The American Museum of Natural History.

The species are all small and belong to the subdivision of *Erax* in which the posterior branch of the third vein meets the margin behind the apex of the wing.

***Erax willistoni*, new species**

Total length: 9–12 mm. A small blackish species with all black legs, the costal margin not dilated in the male, the mystax black above and golden below, abdomen black with white margins and incisures, the seventh segment white in the male and the hypopygium with conspicuous tufts of brownish hairs below. Belongs to Hine's *æstuans* group where the furcation of the third vein is opposite the base of the second posterior cell and the posterior branch of the third vein curves backward at its tip meeting the margin behind the apex of the wing. There are, however, three submarginal cells as in the *anomalus* group.

MALE.—Antennæ, proboscis, palpi, palpal hairs, upper bristles of mystax, occipital bristles and the two long bristles on the ocellar tubercle, black. Beard pale yellow; lower portion of mystax golden. Face golden pruinose on sides, median portion black.

Thorax grayish-yellow pollinose, coxal hairs golden, mesonotal bristles black. Mesonotum with black median line and side spots. Scutellum light gray pollinose with a few fine black hairs on its disc and two marginal black bristles. Legs black. Wings hyaline becoming very lightly suffused with a yellowish tint beyond the middle. Apex light gray. Three submarginal cells as in *Erax anomalus*, etc. Halteres dull yellowish. Abdomen black with margins and incisures white. The seventh segment white. Hypopygium long, slightly narrower than the seventh segment, shining black. The under side with two thick tufts of brownish hairs. Eighth sternite with several long black bristles.

FEMALE.—Similar; ovipositor compressed, black, slightly longer than segments 5, 6, and 7 together.

Holotype, ♂, Chapada, S. W. Williston Collection, no date. Allotype, ♀, Chapada, S. W. Williston Collection, no date. 15 ♂ and 7 ♀ paratopotypes, S. W. Williston Collection, November–January.

***Erax subchalybeus*, new species**

Total length: ♂, 13 mm.; ♀, 18 mm. *Æstuans* group (Hine), the furcation of the third vein beyond the base of the second posterior cell, and the posterior branch of the third vein meeting the margin behind the apex. The species is characterized by the entirely black legs and general bluish-gray color of the body. The costal margin is slightly dilated in the male and the stump vein is slightly shorter than the base of the third vein.

MALE.—Proboscis, palpi, palpal hairs, upper portion of mystax, hairs of vertex and bristles of occiput black. Antennæ missing. Beard and post-genal hairs white as are some of the lower and side hairs of the mystax. Face and occiput whitish pruinose, the ENSEMBLE giving a very light bluish-gray effect. Thorax blue-gray pollinose, the usual median line and side spots being blue-black. Disc of mesonotum covered rather thickly with black hairs. Coxal hairs whitish. Legs black, rather thickly covered with white hairs. Bristles black. The tibiæ and posterior tarsi on the inner side thickly covered with very short, even, fine, golden-brown pile. Wings hyaline

becoming slightly tinged with brownish apically. Scutellum blue-gray with whitish and black hairs and black bristles on the margin. Base of abdomen blue-gray at sides, black dorsally, the posterior margins white, sixth and seventh segments all white, the fifth white with an anterior black spot. A thick patch of black bristles and white hairs at sides of segments 1-4. Hypopygium shining black with black hairs, longer than segments five, six and seven together, and dorsally at base slightly narrower than seventh segment becoming about the same width at seven-eighths of its length.

FEMALE.—Similar to male, the light abdominal markings being more blue-gray than white and proportionately narrower. Ovipositor black, about the length of segments five, six and seven together.

Holotype, ♂, Rio de Janeiro, November, S. W. Williston Collection. Allotype, ♀, Rio de Janeiro, November, S. W. Williston Collection.

***Erax chapadensis*, new species**

Total length: ♂, 14 mm.; ♀, 14 mm. Belongs to *æstuans* group (Hine) and characterized by the black legs with bases of the tibiæ dark brown, the abdomen in the male white, hypopygium large, black, thickly covered with black hairs beneath, and the short third antennal joint which is oval and about two-thirds the length of the first. General coloration grayish with a faint brownish tint as in *E. æstuans* L.

MALE.—Antennæ, proboscis, palpi, palpal hairs, occipital bristles, upper portion of mystax and the two long ocellar bristles, black. Beard white or very faint yellowish, lower portion of mystax pale golden; facial pruinosity grayish. Thorax brownish gray with the usual black markings. Mesonotal bristles black with a few white hairs; coxæ with pale yellow hairs. Legs black, bases of tibiæ dark brown or piceous, bristles black, fine hairs white. A row of stout black bristles on under side of hind femur. Scutellum grayish with fine white hairs. Two long bristles on margin (one black and one yellowish). Wings hyaline or nearly so. Stump vein absent. Costa not dilated. Halteres dark brown. Abdomen, except hypopygium, whitish pollinose with short fine scattered white hairs more or less appressed, eighth sternite keeled below with a marginal fringe of fine white bristles. Hypopygium black, from above narrower than the seventh segment and about the length of the fifth, sixth, and seventh segments together. From the side, the claspers are notched at the apex with a tooth projecting downward at the lower apex. Under side thickly covered with black pile.

FEMALE.—Similar, but a very short stump vein present and with the abdomen gray-pollinose nearly bare dorsally giving the effect of black maculations which cover the tergites except the lateral and posterior margins. Ovipositor black, about as long as segments five, six, and seven together.

Holotype, ♂, Chapada, November, S. W. Williston Collection. Allotype, ♀, Chapada, November, S. W. Williston Collection.

***Erax latiforceps*, new species**

Total length: 15 mm. A grayish species of the *æstuans* group, having all black legs, hyaline wings with three submarginal cells, the costal margin abruptly dilated at two-thirds the distance from base to apex, and the hypopygium from above broader than the seventh segment.

MALE.—Antennæ, proboscis, palpi, palpal hairs, bristles of vertex, occipital bristles, and upper portion of mystax black. Beard, occipital hairs, white. Lower portion of mystax golden. Thorax yellowish gray with the usual black markings. The median line, however, is divided longitudinally by a narrow line of gray. Bristles and hairs of mesonotum black, of pleura whitish, of coxæ pale yellow. Legs black. Scutellum grayish with two black marginal bristles, and many fine white erect hairs on disc. Wings hyaline, an abrupt outward bulge in the costa at about two-thirds the distance from base to apex. The stump vein is prolonged to meet the first longitudinal vein forming three submarginal cells. Abdomen black, base of first segment and sides of 2-5 white, the posterior margins appear to be brownish but this may be due to discoloration and originally may have been narrowly white. Sixth and seventh segments white. Hypopygium black with black hairs (appears to be denuded and under side is partly broken). From above the base appears narrower than the seventh segment but broadens until at about three-fourths its length it is fully as broad as the second segment of the abdomen. Abdomen with a tuft of sordid white hairs at side of first segment and along sides of segments 2-5 becoming shorter posteriorly.

Holotype, ♂, Chapada, S. W. Williston Collection.

***Erax badiapex*, new species**

Total length: ♂, 13 mm.; ♀, 13 mm. A brownish-gray species with mystax composed of black bristles and white hairs, costa dilated in male, and the legs dull reddish except the basal three-fourths of the femora which are black. *Æstuans* group (Hine).

MALE.—Proboscis, palpi, palpal hairs, occipital bristles, hairs of vertex, and a considerable portion of the mystax black. First two joints of antennæ blackish, rest missing. Facial pruinosity yellowish gray. Mystax with black bristles and white hairs. Beard white. Thorax brownish gray with the usual black markings. Scutellum brownish gray with white and a few black hairs. Rather long white hairs and about four black bristles along the margin. Coxal hairs whitish. Legs light reddish-brown except basal three-fourths of femora which is black. Legs with black bristles and fine white hairs. Wings with a faint yellowish tinge, veins reddish, costa dilated. Abdomen black with whitish lateral and posterior margins. Hairs fine, white. Sixth and seventh segments white, hypopygium dark brown with black hairs, from above narrower than seventh segment, rather short and thick.

FEMALE.—Apparently an undersized specimen, somewhat greased. No black hairs or bristles on scutellum. Ovipositor slightly shorter than fifth, sixth, and seventh segments together. Stump vein present in female, absent in male.

Holotype, ♂ Chapada, S. W. Williston Collection. Allotype, ♀, Chapada, S. W. Williston Collection.

***Erax pulchripes*, new species**

Total length: 14 mm. A contrastingly marked species, grayish with golden beard, mystax and tibia. The furcation of the third vein is distinctly before the base of the second posterior cell and the posterior branch of the third vein meets the margin behind the apex of the wing.

MALE.—Antennæ, proboscis, hairs of vertex, occipital bristles, palpi, palpal hairs and a few bristles of upper part of mystax black. Four long ocellar bristles black. Facial pruinosity yellowish gray. Most of mystax and beard golden. Thorax gray with a faint yellowish tinge. Thoracic markings contrastingly black, the median line divided anteriorly by a gray linear streak. Mesonotal bristles black. Scutellum gray with two black bristles at margin and a few very small, fine, white hairs on its disc. Fore coxæ with thick golden hair, other coxæ with paler hair. Femora shining black contrasting sharply with the yellow of the tibiæ. Tarsi, tip of posterior tibiæ, and a line on inner side of median and anterior tibiæ black. Wings hyaline, costa not dilated, halteres light brownish. Abdomen black, the lateral borders broadly and the posterior margins narrowly white. Sixth and seventh segments white. Eighth sternite with black bristles. Hypopygium rather long and slender, reddish brown, nearly bare, the few hairs present black.

Holotype, ♂, Piedra, Brazil, S. W. Williston Collection.

***Erax propinquus*, new species**

Total length: 13 mm. Closely related to *E. pulchripes* from which it differs in having three submarginal cells, the wings having a brownish tinge, the white posterior margins of the abdominal segments broader, and the teeth on the lower side of the tip of the hypopygium yellowish and pointed. The furcation of the third vein is distinctly before the base of the second posterior cell and the posterior branch of the third vein meets the margin behind the apex of the wing. Its general appearance suggests *pulchripes*.

MALE.—Proboscis, palpi, palpal hairs, vestiture of vertex, occipital bristles and antennæ (first 2 segments; rest missing) black. Mystax black above, golden below. Beard pale yellowish, white posteriorly. Thorax light gray, mesonotal disc bluish gray with usual markings blue-black, the median line broadly divided linearly by a blue-gray streak. Femora and tarsi black, tibiæ yellow, except a line on the anterior aspect of the first two and the apical portion of the posterior which is black. Scutellum grayish, denuded. Wings suffused with a brownish tint, base lighter, three submarginal cells, costa not dilated. Halteres pale brown. Abdomen black, the lateral and posterior margins of segments 1-5 broadly white. Segment six mostly white, brownish or blackish anteriorly; segment seven all white. Hypopygium dark brown, produced anteriorly on the under side. A tuft of brown hairs on the under side (basally) and the lower side of the apex has a yellow, downward projecting acute tooth on each side.

Holotype, male, Chapada, S. W. Williston Collection. Paratopotype, male.

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MUTATION IN *CAPITO AURATUS*

BY FRANK M. CHAPMAN

INTRODUCTION

Examination of a large series of barbets from upper Amazonia, recently received by the American Museum, has revealed several facts in distribution and variation of exceptional interest. It soon became clear, however, that any attempt to determine their significance must be preceded by a revision of the group to which the birds belonged. That is, the facts themselves must be defined, as adequately as the available material would permit, in the terms of the systematist: names; characters; extent and nature of variations; boundaries of range.

To my regret I find that the nomenclature of the group is sadly involved. Certain ill-advised changes, accepted without question a quarter of a century ago, require correction to restore us to a situation that we should never have left. It is assuredly a misfortune to have to make unavoidable changes in nomenclature, but to make them when they are needless is a tragedy.¹

Furthermore, in spite of the ancient lineage of the barbets, as such, the group here under review is still actively "speciating" to an extent and in a manner well-designed to confuse the systematist. To the six recognized forms I have found it necessary to add no less than six more, five of which are described as new. Several of the forms proposed are but slightly differentiated, but these differentiations give expression to a condition which can most conveniently and usefully be recognized through the medium of zoological nomenclature.

The distribution of certain of these forms places an additional stumbling block in the path of the classifier. Forms so closely related that they have been considered the same, appear at the extreme boundaries of the range of the species, others so unlike that they have heretofore been considered specifically distinct are found side by side; some have wide ranges, others seem almost to have remained within sound of their type-locality. Finally, the description of races from specimens without

¹I may add that the nomenclatural views here presented are endorsed by my colleagues in the American Museum.

data or labelled with inaccurate localities has made confusion more confounded. Thanks, however, to Mr. W. E. Clyde Todd, who has generously loaned me the superb collection of barbets from the Amazon in the Carnegie Museum, to Mr. Outram Bangs, of the Museum of Comparative Zoölogy, who has sent me two types, and to Dr. W. H. Osgood of the Field Museum, who has contributed a series from Peru, I am in possession of an incomparably finer array of these birds than has ever before been assembled.¹ I venture to hope that it has enabled me not alone to define the races represented but to throw some light on the nature and significance of their variations.

In a word I shall attempt to show that these variations are individual or mutational and not geographic or climatic. In three instances, individuals resembling one race have been found in the habitat of another. It might be suggested that they are of accidental occurrence, but the evidence indicates that they merely express the extent of variation which occurs in this group. This variation apparently arises independent of environment and supplies the stuff of which, under the perpetuating influences of isolation, new forms are evolved.

A study of the origin of new races in the Andes has shown that their appearance is closely related to the degree of segregation, topographic or zonal, which their ranges afford. In Amazonia it is evident that this segregation is supplied by a river system whose broad streams cut this vast area into districts where races living within sight of each other, and apparently under similar conditions, may nevertheless evolve solely through the cumulative effects of isolation acting on inherent variations, the origin of which remains unknown.

The same conclusions were long ago reached in a study of 'The Origin of the Avifauna of the Bahamas,'² in which it was said: "In several instances Bahaman forms inhabiting contiguous islands have become differentiated from each other without, so far as we can observe, being subjected to changed climatic or physiographic conditions.

"We may, perhaps, assume from this that these birds originally owe their characters to individual variations which, among a [limited] number of individuals, have become permanent."

REVISION OF THE *Capito auratus* GROUP

With the exception of the piculets, the barbets are the smallest birds common to the tropics of both hemispheres. Their distribution, therefore, presents in an especially interesting manner the problem of the

¹Specimens not credited to the museums just mentioned are in the American Museum.

²American Naturalist, 1891, pp. 528-539.

geographic origin of tropicopolitan groups. We are here concerned, however, only with certain members of the American genus *Capito* which hitherto have been treated as two species but which a study of the specimens at my disposal indicates should be referred to but one.

Capito contains nine species all confined to the humid Tropical Zone and ranging from Panama to Bolivia, but not to southeastern Brazil. Some are exceedingly rare and known from but few specimens taken at or near the type-locality. Possibly these are decadent or disappearing forms. Others are common, more widely distributed, and plastic. They evidently represent the growing twigs on the *Capito* branch. It is one of these species that forms the subject of this paper. Hitherto it has been known as *Capito amazonicus*, a red-throated bird, and *Capito auratus*, a yellow-throated bird. Of the former, no subspecies were recognized; of the latter, five races were current, as follows:

- auratus auratus*
- “ *aurantiicinctus*
- “ *intermedius*
- “ *bolivianus*
- “ *insperatus*

If my views are correct, we shall have to apply the name *auratus* to the red-throated bird, but as the material examined shows complete intergradation of all the races they will rank as subspecies of *auratus* and the names of most of the existing races will read as before, though the combination will stand for a different relationship.

A list of the races proposed in the succeeding pages follows:

SCARLET-THROATED RACES.

1. *Capito auratus auratus* (Dumont).
2. “ “ *nitidior* Chapman.
3. “ “ *amazonicus* (Deville and Des Murs).

ORANGE-THROATED RACES.¹

4. *Capito auratus orosa* Chapman.
5. “ “ *noraeolindæ* Chapman.
6. “ “ *arinæ* Chapman.

YELLOW-THROATED RACES.

7. *Capito auratus punctatus* Lesson.
8. “ “ *intermedius* Berlepsch and Hartert.
9. “ “ *aurantiicinctus* Dalmás.
10. “ “ *hypochontriacus* Chapman.
11. “ “ *insperatus* Cherric.
12. “ “ *bolivianus* Ridgway.

¹A new group represented by undescribed races in both the Carnegie Museum and the American Museum.

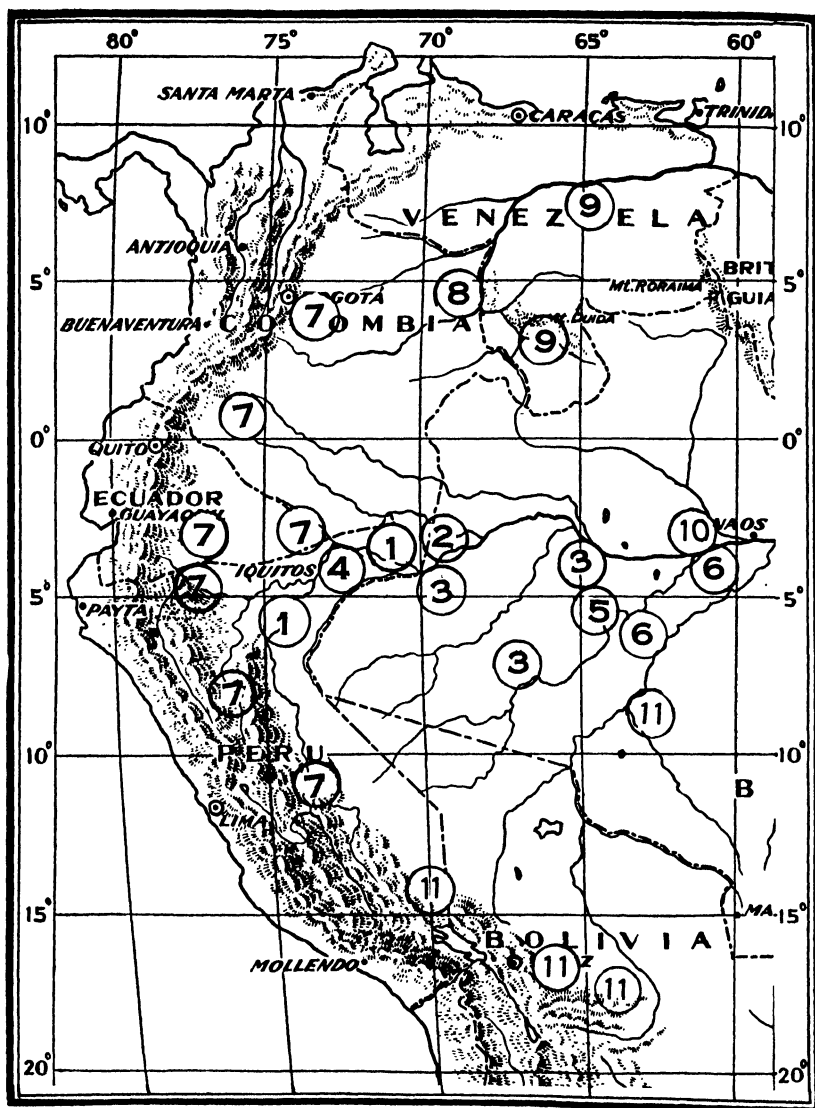


Fig. 1. The Distribution of *Capito auratus*

- | | |
|----------------------------------|------------------------------------|
| 1. <i>Capito auratus auratus</i> | 7. <i>Capito auratus punctatus</i> |
| 2. " " <i>nitidior</i> | 8. " " <i>intermedius</i> |
| 3. " " <i>amazonicus</i> | 9. " " <i>aurantiicinctus</i> |
| 4. " " <i>orosge</i> | 10. " " <i>hypochondriacus</i> |
| 5. " " <i>novaeolindae</i> | 11. " " <i>insperatus</i> |
| 6. " " <i>arimae</i> | 12. " " <i>bolivianus</i> |

These birds are known only in the humid Tropical Zone, east of the Andes from the lower Rio Orinoco south to the department of Santa Cruz, Bolivia, west to the Andes, east to the Rios Madeira and Negro.

1. *Capito auratus auratus* (Dumont)¹

Bucco auratus DUMONT, 1816, Dict. Sci. Nat., IV, p. 54 (based solely on "Le Barbu orangé du Perou" of Levaillant, 1806, 'Hist. Nat. des Ois. de Paradis et des Rolliers suivre de celle des Toucans et des Barbus,' II, p. 63, Pl. xxvii. I suggest Sarayaçu, Peru, on the Rio Ucayali, as the type-locality).

[*Bucco peruvianus* CUVIER, 1817, 'Régne Animal,' I, p. 428; footnote (based on "Le Barbu orangé du Perou" of Levaillant, Pl. xxvii).

Capito auratus SHELLEY, 1891, 'Cat. Birds, B. M.,' XIX, p. 113 (in part, specimens from Pebas only).

Capito peruvianus RIDGWAY, 1914, Bull. U. S. Nat. Mus., 50, part 6, p. 321 (Peruvian references only).

Capito amazonicus of recent authors but not of Deville and Des Murs.

CHARACTERS:—Throat scarlet, unspotted; male with crown yellow-ochre to primuline, the forehead thinly streaked with scarlet, nape like crown sometimes obscurely streaked with black; or forehead and crown heavily streaked or wholly covered with scarlet, extending in varying degrees to the nape which is usually more or less streaked with blackish; rump and flanks, in red-crowned specimens, usually margined with scarlet, in yellow-crowned specimens, usually without scarlet; female, with crown primuline, lightly streaked but not heavily suffused with scarlet; the nape more or less primuline streaked obscurely with black; no orange or cadmium on flanks or rump.

RANGE.—Humid Tropical Zone of the lower Ucayali; (left bank of Solimões at Pebas?).

SPECIMENS EXAMINED

PERU: Both banks Ucayali at Sarayaçu, 7 ♂, 6 ♀; Pebas, left bank Marañon, 1 ♂; mouth Apiyacu, near Pebas, 2 ♂, 3 ♀; Loreto,² near Pebas, 1 ♂.

The series from the Ucayali, which may be considered topotypical, varies more widely than any other I have seen. With the exception of

¹Levaillant's plate, based on a specimen in the collection of M. Raye Breucklerwaert of Amsterdam, unquestionably figures the *Capito* with a red throat and red forehead. It can be closely matched by specimens from Sarayaçu on the Ucayali and from near Pebas, on the Marañon, whereas not one specimen in our series of over 80 yellow-throated birds (*punctatus*) from Colombia, Ecuador, and Peru agrees with it. The latter, indeed, apparently never has the forehead red as in the bird figured and described by Levaillant.

Dumont's name is based solely and exclusively on Levaillant. His description is merely an abridged and slightly altered reprint of the one accompanying Levaillant's plate to which he refers. He gives the type and he mentions no specimen other than the one on which Levaillant's plate was based. That he had no other specimen seems proved by the fact that after a discussion, largely in Levaillant's words, of the status of this species, which Levaillant suggested might be a climatic variety of the Guianan species, he adds: "jusqu'à ce que l'inspection d'autres individus ait fourni le moyen d'avoir une solution complète à cet égard, on croit lui devoir laisser une dénomination spécifique."

The statement by Dalmás (1900, Bull. Soc. Zool. de France, XXV, p. 178) that Dumont's "type" of *auratus*, in the Paris Museum, is a specimen of the common form of Ecuador and Colombia, in other words, the yellow-throated bird previously known as *Capito punctatus*, does not, therefore, affect the applicability of the name *auratus* to the "Barbu orangé du Perou" of Levaillant. In the primary application of the names *auratus* and *punctatus* we may thus return to the nomenclature of the British Museum Catalogue.

This view is now confirmed by Dr. J. Berlioz who kindly writes me that he is unable to find a type of Dumont, either in the collections or on the registry of the Muséum National d'Histoire Naturelle, and that as all their specimens of *Capito auratus* and *Capito amazonicus* were received subsequent to 1820 it is difficult to see how any of them could have served as a type for Dumont in 1816.

²Coll. Field Museum.

females from Tonantins every other red-throated race can be matched, or nearly matched, by this Sarayaçu series. It was collected on both sides of the Ucayali, but this fact does not explain its variations since examples of opposite extremes were taken on both sides of the river.

There are both males and females in which the throat is as pale as in the orange-chrome throated races from Orosa, Caviana and Arima. The crown, rump and flanks vary greatly in the male and but little in the female, but both sexes show the interesting variation, presented by the squamate-throated bird from eastern Ecuador (see *punctatus*) of having the rump and upper tail-coverts terminally margined instead of laterally bordered.

Three males and three females from near Pebas are intermediate between specimens from Sarayaçu and Tonantins. On geographical grounds they should be placed with the latter, particularly since from Puerto Indiana at the mouth of the Napo we have only *punctatus*. But in characters they are, on the whole, nearer to the Sarayaçu series. None of the females has orange or reddish on the rump; two have the paler crown and covert margins of *auratus*, but the third is near the Tonantins form in these respects.

2. *Capito auratus nitidior*, new subspecies

CHARACTERS.—The most richly colored form; the female, as well as the male, with the crown heavily streaked or wholly suffused with scarlet. Male not distinguishable from the most highly colored males of *auratus auratus* Dumont from the Ucayali; the flanks in six of seven specimens, the rump in all, washed or margined with scarlet; female similar to female of *auratus auratus* but crown much redder, as red as in the male; margins of the median and lesser wing-coverts deeper, Mars yellow instead of cadmium-yellow; margins on rump darker than those on foreback or upper tail-coverts; throat averaging less orange, more scarlet-red; the underparts less heavily streaked.

TYPE.—No. 97,093, Carnegie Museum; ♀ ad.; Tonantins, Brazil, left bank Rio Solimões, below mouth of Putumayo; July 6, 1923; S. M. Klages.

RANGE.—Known only from the type-locality; doubtless confined to the north side of the Solimões.¹

SPECIMENS EXAMINED

BRAZIL: Tonantins,² 7 ♂, 9 ♀.

This is a stable race, exceedingly constant in all its characters. The males can be matched by three specimens in a series of seven from near Sarayaçu, Peru. Not one of the nine females has its counterpart in our twenty-two specimens of the red-throated group from south of the Amazon.

¹Specimens obtained by Natterer on the Rio Negro (see Hellmayr, 1907, Nov. Zool., XIV, p. 8) may belong here.

²Coll. Carnegie Museum.

3. *Capito auratus amazonicus* Deville and Des Murs

C[apito] amazonicus DEVILLE AND DES MURS, 1849, Rev. et Mag. de Zool., p. 171 ("Ega et de Santa-Maria." *op. cit.*, p. 169. I propose Egr¹). DALMAS, 1901, Bull. Soc. Zool. de France, XXV, p. 178, footnote (in part). HELLMAYR, 1907, Nov. Zööl., XIV, p. 81 (Ega).

Capito auratus (not of Dumont) SHELLEY, 1891, 'Cat. Birds B. M.', XIX, p. 113 (Ega spec. only).

Capito aurantiiventris RIDGWAY, 1912, Proc. Biol. Soc. Wash., XXV, p. 87; type No. 7601 (examined), Mus. Comp. Zööl., from "an unknown locality in the upper Amazon Valley."²

CHARACTERS.—With less red on the head than in any other scarlet-throated race, but with the flanks usually, and the rump always margined with cadmium or orange-chrome; throat flame-scarlet to scarlet, unspotted; male with crown primuline to analine-yellow, faint red streaks or suffusion, if present, confined to the forehead; nape more or less tinged with the color of the crown and obscurely streaked with black; rump, flanks, and, to a lesser degree, abdomen usually margined or washed with orange-chrome; female with nape more streaked; rump margined with orange; flanks and abdomen with usually a faint orange wash. Differs from *auratus auratus* chiefly in having less red on the crown and in the presence of orange margins on the rump and, usually, flanks and abdomen; from *nitidior* by the comparative absence of red on the crown.

RANGE.—Humid Tropical Zone; right bank of the Solimões from at least São Paulo de Olivença eastward to Teffé or beyond, southward to Hyutanahan on the left bank of the Rio Purus.

SPECIMENS EXAMINED

BRAZIL: Coll. by Newton Dexter, probably at Teffé,³ 3 ♂ (inc. type of *aurantiiventris* Ridgway), 1 ♀; Teffé, 2 ♂, 2 ♀; São Paulo de Olivença, right bank Rio Solimões, long. 69°, 7 ♂, 9 ♀; Hyutanahan,⁴ left bank upper Rio Purus, 8 ♂, 4 ♀.

¹These type-localities have hitherto been cited as "Santa Maria and Ega." That combination of these names, with the addition of "et des bords du Rio Javari," occurs on p. 167 of this paper, where the authors, in referring to their collection, mention all the localities from which it came. One page later, when about to discuss the relationships of the Amazon bird, they write: "C'est ce que de nombreux individus que nous avons rapportés d'Ega et de Santa-Maria, sur d'autres affluents de la rive droite et gauche du Haut-Amazone. . . ." It is, therefore, from this association of names that we should fix the type-locality of *amazonicus*. The matter is of importance, for although I am unable to discover the situation of Santa Maria, the fact that Ega (= Teffé) is on the right bank of the Solimões forces the conclusion that Santa Maria is on the left and it is doubtless, therefore, the home of another race of *auratus*, possibly the one herein described as *nitidior*. The fact that the authors include the Rio Javari (whence they apparently describe an orange-throated bird) in their first mention of localities shows that they were not there specifically referring to the localities whence came the red-throated bird which they subsequently described, "d'Ega et de Santa Maria." See also my remarks beyond under *C. a. orose*.

²Since the above was written, Dr. J. Berlioz, in reply to my inquiry, writes from Paris that the collections in the National Museum of Natural History contain three specimens labelled as the "type" of *Capito amazonicus* of Deville and Des Murs. All three bear only the locality "Brasil." In default therefore, of a type bearing full data Ega must evidently be accepted as the type-locality for *amazonicus*.

³There is but little doubt that the three males and a female, on which Ridgway based his *aurantiiventris*, which were collected by Newton Dexter while a member of the Agassiz Expedition to Brazil, were taken at Teffé (=Ega) and that they are topotypical of, and hence synonymous with, *Capito amazonicus* from the same locality. From Mrs. Agassiz's account of this expedition ('A Journey in Brazil', 3rd Ed., 1868) it appears that its members collected at Teffé from September 25 to October 21, 1865. Under date of October 17, she writes: "Mr. Dexter procured a large number of forest birds for mounting—papageios, toucans, and a great variety of small species of very brilliant plumage" (p. 242). Furthermore, from neither of the remaining localities at which Dexter collected (Manaus and the Tapajoz) has a red-throated *Capito* been recorded. When, in addition to these facts, it is found that Dexter's specimens are not separable from a series from São Paulo de Olivença, west of Teffé, and like it on the right bank of the Solimões, or from a series from Hyutanahan on the Rio Purus south of Teffé, and the identity of *aurantiiventris* with *amazonicus* seems fairly proved.

⁴Coll. Mus. Comp. Zööl., 2 ♂, 1 ♀.

⁵Coll. Carnegie Mus.

Accepting the four specimens collected by Dexter as topotypical of *amazonicus*, the series from São Paulo de Olivença is essentially typical of this race.¹ Individual variation in this series is found in the coloration of the head, which, in about half the series, is wholly without red and in the remainder the forehead is finely streaked with red; in the presence or absence of orange or sienna margins on the rump and flanks (absent in 2 ♂, 2 ♀, out of 17 specimens), and in the color of the throat, which ranges from scarlet to scarlet-red.

The Hyutanahan series is equally close to the Dexter birds but the orange margins on flanks and rump may be a little less pronounced. There is less individual variation in this series than in that from São Paulo de Olivença. Only one specimen shows evident trace of red in the forehead, and all but an immature female have orange on the rump and flanks. The throat is scarlet-red in all but one specimen, a male, in which the throat is very near that of *novaeolindæ*.

4. *Capito auratus orosæ*, new subspecies

CHARACTERS.—Throat unspotted orange-chrome, intermediate in color between that of *auratus auratus* Dumont and *auratus punctatus* Lesson; crown primuline to analine-yellow; forehead brighter, with, in some specimens, faint, barely perceptible traces of red; no orange on flanks, the margins of the rump feathers little if any darker than those of foreback and rump. Most closely resembling *Capito auratus arima* Chapman, of the right bank of the lower Purus, but without orange on flanks and rump.

TYPE.—No. 231,307, Amer. Mus. Nat. Hist.; ♂ ad.; right bank of Rio Marañon near mouth of Rio Orosa, Peru, opposite a point midway between Pebas and the mouth of the Napo; Oct. 5, 1926; Olalla and Sons.

RANGE.—Known only from type-locality, but possibly extending eastward to the Rio Javari.

SPECIMENS EXAMINED

PERU: Orosa, 6 ♂, 1 ♀.

The males are constant in color but the single female has the throat as yellow as in average specimens of *punctatus*. In the color of the crown and absence of orange from flanks and rump it agrees with the male. Since this specimen has an unspotted throat it cannot be considered an example of *punctatus*, of accidental occurrence from the opposite side of the river; while the known ranges of forms having a yellow, unspotted throat are too distant to warrant its being referred to one of them. This specimen measures: wing 90; tail 54; culmen 24 mm., and is thus further unusual in having an exceptionally long wing. Apparently it represents an extreme case of individual variation. It was collected on October 30,

¹Two males and two females since received from Telfé confirm this belief.

one of our six males being taken the same day. As noted beyond, a similar yellow-throated specimen occurs in the series of the orange-throated *novaolindæ*.

It seems not improbable that this is the *Capito peruvianus* of Deville and Des Murs. The bird they describe¹ formed a part of their collection from "Santa Maria, d'Ega et des bords du Rio Javari." It presumably came from the latter river which it is not unlikely may form the eastern boundary of the range of *orosæ*. They describe a bird with an orange throat, while the bird subsequently described as *amazonicus* from Ega and Santa Maria is said to have a red throat. It was chiefly this difference that induced these authors to suggest, provisionally, a name for the Amazon bird. If they had possessed a specimen of true *peruvianus* Cuvier, or as it is here called, *auratus* Dumont, it is not probable that they would have described a form "d'Ega et de Santa Maria." Singularly enough they make no mention of Dumont's name, although it was published 33 years prior to the date of their paper, and in Paris.

5. *Capito auratus novaolindæ*, new subspecies

CHARACTERS.—Similar to *Capito auratus amazonicus* Deville and Des Murs, but with the throat flame-scarlet instead of scarlet or scarlet-red; forehead with less red (usually no red); margins of rump feathers paler, cadmium-yellow rather than raw sienna; similar to *Capito auratus arimæ* Chapman of the right bank of the lower Purus, but throat flame-scarlet instead of orange-chrome. Closely resembling specimens of *auratus auratus* Dumont from Sarayaçu which have no red on head, but flanks and rump with orange.

TYPE.—No. 92,058, Carnegie Museum; ♂ ad.; Nova Olinda, left bank Rio Purus, Brazil; July 20, 1922; S. M. Klages.

SPECIMENS EXAMINED

BRAZIL: Nova Olinda,² 6 ♂, 7 ♀.

RANGE.—Known only from the type-locality.

This race is almost squarely intermediate between *amazonicus* and *arimæ* and while the characters on which it is based are slight, they are sufficiently pronounced and constant to prove the interesting biological fact that the opposite banks of the lower Purus have different, even if very closely allied, races of *Capito auratus*.

Included in the series of thirteen specimens, all taken at Nova Olinda between July 14 and August 2, 1922, is an adult female taken July 31, in which the throat is as yellow as in average specimens of *punctatus*¹ In all other respects, including an unspotted throat, it agrees with *novaolindæ*. It may be argued that this is an individual of *hypochondriacus*

¹1849, Rev. et Mag. de Zool., p. 168.

²Coll. Carnegie Museum.

of accidental occurrence from the north side of the Amazon, but in my opinion, like the similar specimen of *orosæ*, it is a mutant example of the race with which it was found associated.

6. *Capito auratus arimæ*, new subspecies

CHARACTERS.—Resembling *Capito auratus orosæ* Chapman, of the right bank of the Marañon, in having the throat unspotted orange-chrome, intermediate in color between that of *auratus auratus* Dumont and *auratus punctatus* Lesson, but differs from *orosæ* in having the flanks and rump margined with orange.

TYPE.—No. 93,055, Carnegie Mus.; ♂ ad.; Arima, right bank lower Rio Purus, Brazil; Sept. 19, 1922; S. M. Klages.

RANGE.—Humid Tropical Zone; right bank of the lower Rio Purus, Brazil, from the Amazon at least to Arima.

SPECIMENS EXAMINED

BRAZIL: Arima,¹ 9 ♂, 11 ♀; Caviana,¹ right bank Solimões opposite Manacapará, 3 ♂, 2 ♀.

In its orange-chrome throat this race resembles *orosæ* of the right bank of the Marañon. In its orange tinted flanks and rump it is like *hypochondriacus* of the opposite side of Solimões. It is fairly constant in color but in my series of 28 specimens two males and one female, all from Arima, have the throat as deeply colored in as *novaolindæ* of the opposite bank of the river.

7. *Capito auratus punctatus* Lesson

Capito punctatus LESSON, 1831, 'Traité d'Orn.,' p. 165 (no locality: I suggest Buena Vista, Colombia, in the eastern Bogotá region).² SHELLEY, 1891, 'Cat. Birds B. M.,' XIX, p. 112 (in part, Colombia, Ecuador and Peru specimens only).

Micropogon flavicollis BONAPARTE, 1837, Proc. Zool. Soc., p. 120 (Brazil bordering Peru).

Capito auratus (not of Dumont) DALMAS, 1900, Bull. Soc. Zool. de France, XXV, p. 178, footnote.

Capito auratus auratus (not of Dumont) HELLMAYR, 1907, Nov. Zool., XIV, p. 82 (Chuchuras and Pozuzo, Prov. Huánuco, C. Peru; Valle, upper Huallaga; Rio Napo, Ec.; Bogotá colls.). CHAPMAN, 1917, Bull. Amer. Mus. Nat. Hist., XXXVI, p. 326 (La Morelia, Florencia, Villavicencio, Buena Vista, Col.); 1921, Bull. U. S. N. M., 117, p. 73; 1926, Bull. Amer. Mus. Nat. Hist., LV, p. 342 (Macas region, Rio Suno, below San José, Ec.).

CHARACTERS.—Throat cadmium-yellow to orange, spotted with black in the female; crown and nape varying from analine-yellow through orange-citrine to medal-

¹Coll. Carnegie Mus.

²It may be argued that Lesson's description, based on a male without locality, is not certainly identifiable: to which it may be replied that Lesson's description does apply to the species in which the female has a spotted throat and that at the time he wrote it is probable that our only specimens of the yellow-throated *Capito* were from the countries in which only this form is found. As the region from which it is most probable that his specimen came, I suggest Buena Vista in the eastern Bogotá area as the type-locality of this form. When it can be definitely shown that Lesson's name was based on some form other than the one for which it is here used there will then be reason for refusing to use it for a species to which for many years it was applied.

bronze; the forehead usually with a more golden or yellow tint, the color of the crown less pronounced on the nape in the female than in the male; rump margined with yellow of foreback and upper tail-coverts, flanks and abdomen with yellow of breast; these parts, therefore, normally without cadmium or orange margin or wash.

RANGE.—Humid Tropical Zone at the eastern base of the Andes from the Bogotá region (Buena Vista) of Colombia, south to the Rio Perené and the junction of the Rios Ucayali and Urubamba, Peru.

SPECIMENS EXAMINED

PERU: Junction Urubamba and Ucayali, 1 ♂; Lagarto, right bank upper Ucayali, near mouth Urubamba, 3 ♂, 3 ♀; Perené, 1 ♂; Monte Alegre, Pachitea, 1 ♀; Pozuzo,¹ 1 ♂; Huachipa,¹ left bank Rio Chinchao near junction with Rio Huallaga. 4 ♂, 2 ♀; Vista Alegre,¹ opposite Huachipa, 2 ♂; Rio Seco, 30 m. west of Moyobamba, 4 ♂, 3 ♀; Rio Negro, W. Moyobamba, 1 ♂; Moyobamba,¹ 1 ♂, 1 ♀; Santa Rosa, Marañon, below mouth of Chinchipe, 2 ♂, 1 ♀; Pomará, near Santa Rosa, Marañon, 2 ♂, 2 ♀; Puerto Indiana, left bank of the Marañon near mouth of Napo, 5 ♂, 3 ♀. ECUADOR: Mouth Rio Curaray and Napo, 8 ♂, 4 ♀; Rio Suno, 4 ♂, 4 ♀; below San José de Sumaco, 3 ♂; Macas region, 1 ♂. COLOMBIA: La Morelia, 1 ♀; Florencia,² 1 ♀; Buena Vista, above Villavicencio, 3 ♂, 4 ♀.

The specimens listed were all collected at comparatively recent dates and are accompanied by full data. They represent the known range of this form and should give some conception of its geographic and individual, or mutational, variations. So far as the former are concerned I find none that can be definitely associated with locality. The crown is the most generally variable character and its entire range of color is shown in series from the same locality; e.g., Puerto Indiana and Curaray. It is noteworthy, therefore, that although *punctatus* has far more extensive range than any other member of the group it exhibits no recognizable racial variation.

Its individual variations, however, are pronounced and significant. Those of the crown, for example, cover the range of geographic variation in all the yellow-throated races. That is, the crown in both *insperatus* and *aurantiicinctus* can be matched by examples of *punctatus* from Ecuador.

In the female from Monte Alegre, Peru, the crown is Sudan-brown, brighter on the forehead, and thus very closely approaches in this respect the type of *bolivianus*. The heavily spotted throat of this specimen is Mars-yellow, darker than that of any other bird in our series. The margins of the wing-coverts are also deeper, raw sienna instead of chrome, and those of the greater coverts are of essentially the same color as those of the remaining coverts. The specimen is further unusual in having whitish, not yellowish, postocular and nuchal streaks and in the nearly

¹Coll. Field Museum.

²Coll. Mus. Comp. Zool.

complete absence of streaks on the auriculars. The markings of the median wing-coverts differ from the normal in pattern as well as in color. In all our remaining females these are distinctly and evenly margined, but in the Monte Alegre bird they are subterminally marked with bars that do not reach the shaft. The same character is shown to a lesser degree on the lesser coverts. While the breast and abdomen of this specimen is soiled and darkened, this fact does not account for its brown crown and other marked characters. The receipt of a normally colored specimen of *punctatus* from Pozuzo, near Monte Alegre, leads to the conclusion that the Monte Alegre bird is not a representative of a highly localized race but a mutant example of *punctatus*. Its resemblance in head color to the type of *bolivianus* suggests the possibility of that bird being a mutant of *insperatus*.

Continuing the description of individual variation in *punctatus*: two males, one from Puerto Indiana the other from the mouth of the Curaray, have the flanks washed with deeper yellow than that of the breast and thus resemble some examples of *aurantiicinctus*. A related variation is shown by several specimens in which the margins of the rump feathers are slightly deeper than those of the foreback and upper tail-coverts. The most interesting and suggestive individual variation, or mutation, in *punctatus*, however, is found in the markings of the throat. The heavily spotted throat of this form is the most marked and constant racial character shown by any member of the entire group. Throughout the thousand or more miles covered by the range of this race it shows, as has been said, no appreciable geographic variation nor evidence of intergradation with allied races. It is, it is true, a representative form, but so are many birds whose specific standing is undoubted. The spotted throat of the female, a character of kind not of degree, the constancy of this marking, and the absence of anything approaching intergradation is the evidence to be considered, and if there were no other, I should treat *punctatus* as specifically distinct and leave it to the objector to prove the contrary. But the bird's status is apparently removed from the field of discussion by the occurrence in our series of twelve specimens from Curaray, on the Napo, of a female in which the throat is so nearly immaculate that it can be almost exactly matched, in this respect, by a specimen of *insperatus* from the type-locality. This specimen evidently demonstrates, therefore, the intergradation of *punctatus* with the group in which the female has the throat unspotted, by individual variation.

Further tendency in this race to vary individually is shown by a female from the Rio Suno in Ecuador, one of a series of eight from that place. In this bird the feathers of the throat lack the usual large roundish

or guttate terminal spots, but their exposed portion has a well-defined black crescent margined with a fine fringe of orange, giving the throat a strongly scaled appearance. The feathers of the upperparts, and particularly those of the rump, are terminally, rather than laterally, margined with yellow. Given isolation and a breeding stock and there is the material in these variations for the establishment of a well-marked form.

Our series of *punctatus*, therefore, shows sufficient individual variation to cover, not only all the characters distinguishing the yellow-throated races, but others which have not yet found opportunity for racial expression.

8. *Capito auratus intermedius* Berlepsch and Hartert

Capito auratus intermedius BERLEPSCH AND HARTERT, 1902, Nov. Zoöl., IX, p. 98 (Nericagua, near Maipures, Rio Orinoco). HELLMAYR, 1907, Nov. Zoöl., XIV, p. 92 (Nericagua specimens only); 1919 (1920), Archiv für Naturg., 85, p. 122 (Nericagua, Munduapo; crit.).

CHARACTERS.—Throat from cadmium-yellow to orange, unspotted in both sexes; the flanks and rump without orange or cadmium.

RANGE.—Known only from Nericagua and Munduapo on the Rio Orinoco in the Maipures region.

SPECIMENS EXAMINED

None.

Three males and a female of this form are known. They differ from *aurantiicinctus* in the absence of orange or cadmium on the flanks and rump. Some specimens from the Cunucunuma, near Mt. Duida, very closely approach this condition, while others show the characters of *aurantiicinctus*. A larger series, therefore, is required to determine the status of *intermedius*.

9. *Capito auratus aurantiicinctus* Dalmás

Capito aurantiicinctus DALMÁS, 1900, Bull. Zool. Soc. France, XXV, p. 177 (Rio Caura, lower Orinoco, Ven.).

Capito auratus aurantiicinctus BERLEPSCH AND HARTERT, 1902, Nov. Zoöl., IX, p. 99 (Caura River, Ven.; crit.). HELLMAYR, 1907, Nov. Zoöl., XIV, p. 82 (Caura River, Ven.; (?) Barcellos, Rio Negro). CHAPMAN, 1921, Bull. U. S. Nat. Mus., 117, p. 73 (crit.).

Capito auratus (not of Dumont) RIDGWAY, Bull. U. S. Nat. Mus., 50, part 6, p. 320, footnote (Rio Caura, Ven.; crit.).

Capito auratus intermedius (not of Berlepsch and Hartert), CHAPMAN, 1917, Bull. Amer. Mus. Nat. Hist., XXXVI, p. 326 (Cunucunuma River, Ven.; crit.).

CHARACTERS.—Throat cadmium-yellow to orange unspotted in both sexes; forehead sulphine-yellow to orange-citrine; nape usually decidedly darker, Saccardo's olive to medal bronze, uniform or slightly margined with black; flanks, in some specimens, slightly tinged with cadmium-yellow, the rump feathers margined with light cadmium or orange noticeably different from the lemon-yellow margins of the fore-back and upper tail-coverts.

RANGE.—Humid Tropical Zone in Venezuela from the right bank of the Orinoco, near the mouth of the Caura, south to Duida and probably the upper Rio Negro.

SPECIMENS EXAMINED

VENEZUELA: La Union, lower Rio Caura, 2 ♂; upper Rio Caura,¹ 2 ♂; Rio Cunucunuma, east of Mt. Duida, 4 ♂, 2 ♀.

The type series of this race was taken on the Caura River (exact locality not stated) in 1897 and 1898. I have two males collected by Klages at La Union on the Caura, in 1901, which may be considered topotypical. In the color of the crown they agree with Buena Vista, Col. (above Villavicencio), specimens of *punctatus*. One has the flanks slightly washed with cadmium-yellow, the rump with orange; the other has no trace of this color on the flanks but has the rump margined with light cadmium.

Two males collected by Klages in 1909, on the "upper" Caura River, have the forehead sulphine-yellow, the nape dark Saccardo's olive, the flanks are without orange but are a shade deeper yellow than the breast, and the rump is margined with light cadmium.

Four males and two females from the Rio Cunucunuma east of Mt. Duida on geographical grounds should be referable to *intermedius* rather than to *aurantiicinctus*. Nericagua on the Orinoco above Maipures, the type-locality of *intermedius*, is distant only about 150 miles from Cunucunuma, while Suapure, the probable type-locality of *aurantiicinctus*, is distant about 300 miles from that locality. While questioning the distinctness of *intermedius* from *aurantiicinctus* (1917, Bull. A. M. N. H., XXXVI, p. 326), I have previously referred the Cunucunuma birds to the former. In only two of them (both males) is the yellow of the flanks deeper than that of the breast, but in all the margins of the rump feathers are at least faintly deeper than those of the foreback and rump, though no more so, however, than in some specimens of *punctatus*. I am still, therefore, of the opinion that these Cunucunuma birds could be matched by specimens from Nericagua.

In the color of the crown five of the Cunucunuma birds are essentially like the two upper Caura specimens, the sixth (A. M. N. H. No. 120,481) the forehead is between raw sienna and antique brown and in this respect thus approaches the type of *bolivianus*, as I have before remarked (1921, Bull. U. S. N. M., 117, p. 74).

Natterer's specimens from Barcellos on the right bank of the lower Rio Negro, referred by Hellmayr to *aurantiicinctus* (*loc. cit.*), should probably be placed with *hypochondriacus* herein described from Mana-

¹Coll. Carnegie Mus.

caparú on the narrow strip of land between the Rios Negro and Solimões, opposite Manaos.

10. *Capito auratus hypochondriacus*, new subspecies

CHARACTERS.—Similar to *Capito auratus insperatus* Cherrie of Bolivia but with the feathers of the flanks, abdomen and rump strongly margined with rich cadmium-yellow, the sulphine-yellow of the forehead not so definitely extended to the nape, which is more conspicuously marked with black. Similar to *Capito auratus aurantiicinctus* Dalmas of Venezuela but flanks, abdomen and rump more strongly and more uniformly marked with cadmium-yellow, the crown averaging yellower, the nape blacker, and both without the brownish tinge often present on the crown, and usually on the nape of *aurantiicinctus*. Wing and tail averaging shorter than in either *insperatus* or *aurantiicinctus*.

TYPE.—No. 99,678, Carnegie Museum; ♂ ad.; Manacaparú, left bank Rio Solimões, near its junction with the Rio Negro, Brazil; June 19, 1924; S. M. Klages.

RANGE.—Right bank of the Rio Negro from its mouth northward an unknown distance.

SPECIMENS EXAMINED

BRAZIL: Manacaparú,¹ 4 ♂, 4 ♀.

MEASUREMENTS

	Wing	Tail	Culmen
3 ♂	79, 81, 84	45, 47, 49	24, 25, 25 mm.
3 ♀	78, 81, 82	46, 46, 47.5	22.5, 23, 23.5 mm.

The characters distinguishing this form are constant in the ten specimens from the type-locality. It is noteworthy that the feature of a "golden belt," on which the form of the Rio Orinoco is based, is far more pronounced in this race than in that one. Specimens collected by Natterer at Barcellos, on the right bank of the Rio Negro, above the mouth of the Rio Branco, are probably to be referred to this race rather than to *aurantiicinctus*. This appears to be the only form differing in size from other members of the group. Some of the specimens, however, are molting and the series measured is not large enough to present conclusive results.

11. *Capito auratus insperatus* Cherrie

Capito auratus insperatus CHERRIE, 1916, Bull. Amer. Mus. Nat. Hist., XXXV, p. 391 (Todos Santos, Rio Chaparé, Bolivia). CHAPMAN, 1921, Bull. U. S. Nat. Mus., 117, pp. 72, 73 (Todos Santos; Mission San Antonio; Rio San Antonio, Bolivia. Rio Cosireni; Astillero, S. E. Peru).

Capito punctatus (not of Lesson) BERLEPSCH AND STOLZMANN, 1906, Ornith., XIII, p. 123 (Rio Cadena, S. E. Peru).

Capito auratus intermedius (not of Berlepsch and Stolzmann) HELLMAYR, 1910, Nov. Zööl., XVII, p. 395 (Calama, right bank upper Madeira, Brazil).

¹Coll. Carnegie Mus.

Capito auratus bolivianus (not of Ridgway) HELLMAYR, 1919 (1920), Archiv für Naturg., 85, p. 121 (Yahuarmayo, San Goban, Chaquimayo, Rio Huacamayo, Marcapata, S. E. Peru).

CHARACTERS.—Throat cadmium-yellow to orange, unspotted; forehead usually sulphine-yellow, but infrequently approaching citrine, its color extending well on to the nape, which is obscurely streaked with blackish; flanks and abdomen of the same yellow as the breast and without trace of cadmium-orange; margins of rump feathers pale lemon-yellow, of same shade as those of foreback and rump.

RANGE.—Humid Tropical Zone of Bolivia north at least to Calama, Brazil, on the right bank of the Rio Madeira, west to southeastern Peru.

SPECIMENS EXAMINED

BOLIVIA: Rio Yapacani,¹ Dept. Santa Cruz, 2 ♂, 2 ♀; Rio Surutu,¹ Dept. Santa Cruz, 1 ♂, 2 ♀; Todos Santos, Dept. Cochabamba, 3 ♂ (inc. type), 2 ♀; Mission San Antonio, Rio Chimoré, Dept. Cochabamba, 4 ♀. S. E. PERU: Astillero, 1 ♂.

The characters of this form are on the whole constant, but one male and one female from Rio Yapani and a female from Mission San Antonio have the margins of the rump slightly deeper yellow than that of the foreback and upper tail-coverts.

12. *Capito auratus bolivianus* Ridgway

Capito auratus bolivianus RIDGWAY, 1912, Proc. Biol. Soc. Wash., XXV, p. 87 ("Rio Beni,² Bolivia"; No. 47,379, Coll. Mus. Comp. Zool.). CHAPMAN, 1921, Bull. U. S. N. M., 117, p. 74 (crit.).

CHARACTERS.—Male with throat orange, forehead and crown antique brown, rump margins of the same color as those of foreback and upper tail-coverts; abdomen with a very faint suggestion of cadmium-yellow. Female unknown.

RANGE.—Unknown.

SPECIMENS EXAMINED

The type and only known specimen, No. 47,379, Mus. Comp. Zool. No definite locality.

I can add nothing to what I have already said about this bird (*loc. cit.*). The crown is unlike that of any other specimen seen by me but is most closely approached by that of a bird from the Cunucunuma, upper Orinoco. It is possibly significant that the range of variation in the color of the crown in our specimens from the Rio Cunucunuma is nearly as great as that existing between *bolivianus* and *insperatus* suggesting, therefore, that the type of *bolivianus* is a mutant of *insperatus* and hence may have come from Bolivia. On the other hand, *insperatus* is constant in color and not one of my seventeen specimens, covering the range of the species, from Santa Cruz to southeastern Peru, shows the slightest suggestion of a brown crown; whereas *aurantiicinctus* is a variable form.

¹Coll. Carnegie Mus.

²The locality is evidently erroneous. The type, a flat skin, was found by Dr. Thomas Barbour attached to an Indian necklace in a museum in La Paz, Bolivia (Chapman, *loc. cit.*).

The wide-ranging *punctatus*, however, is also fairly constant but there are several strangely marked mutants in our series of over 80 specimens, one of which, from Monte Alegre, Peru, has a brown crown.

AVERAGE MEASUREMENTS OF FIVE MALES

(In millimeters)

	Wing	Tail	Culmen
<i>C. a. auratus</i> , Sarayaçu, Peru	86.5(84-88)	52.5(51-54)	24.6(23 -25.5)
" <i>nitidior</i> , Tonantins, Brazil	86.0(84-88)	52.8(51-56)	24.2(24 -25)
" <i>amazonicus</i> , Hyutanahan, Brazil	85.5(85-86)	53.0(52-54)	23.6(23 -25)
" <i>orosæ</i> , Rio Orosa, Peru	85.1(84-87)	52.9(52-54)	24.4(23 -26)
" <i>arimæ</i> , Arima, Brazil	85.0(84-86)	52.4(51-55)	24.2(24 -25)
" <i>novaolindæ</i> , Nova Olinda, Brazil	86.2(84-88)	51.6(50-53)	24.0(23 -25)
" <i>punctatus</i> , Rio Curaray, Ec.	85.0(83-87)	52.6(52-54)	24.0(23.5-24.5)
" <i>aurantiicinctus</i> , ¹ Mt. Duida, Ven.	84.0(81-85)	51.4(50-53)	24.3(23.5-25)
" <i>insperatus</i> , Todos Santos, Yapacani, Bol.	85.0(83-88)	52.4(51-53)	24.5(24 -25.5)
" <i>hypochondriacus</i> , ² Manacapará, Brazil	81.3(79-84)	47.0(45-49)	24.6(24 -25)
" <i>bolivianus</i> ³ ?		52.0	25.5

SUMMARY AND CONCLUSIONS

From the data contained in the preceding review, I present now a summary of what appear to be the more salient facts together with my conclusions concerning them.

VARIATIONS

It is a well-known but unexplained fact that certain species or groups of birds may vary in quite different ways. Some may be variable in size and stable in color, with others the reverse occurs. Again variations in size may affect one part in one species, another part in another species. Likewise, differences in color and in pattern of marking are restricted to certain areas in one species to other areas in another species. The superciliary, pectoral band, wing-bars, outer rectrices, are parts frequently affected, but the entire plumage may be more or less involved. Where the variations are apparently to be attributed to climatic influences, darker colors being associated with humid conditions, paler colors with arid conditions, the range of individual, that is, local variation is comparatively limited; but where the variation is mutational, the range of local or individual variation is comparatively wide. We should not, for

¹Four specimens only.²Three specimens only.³Type; primaries missing.

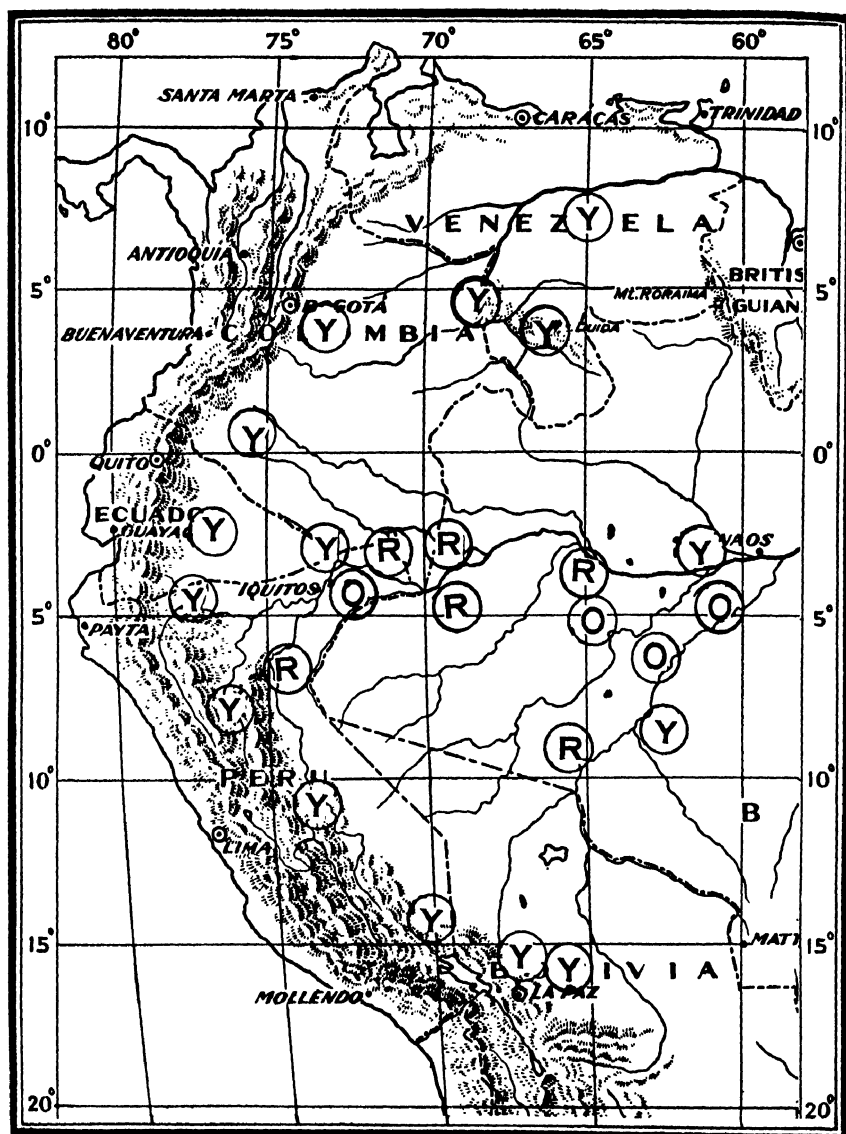


Fig. 2. The Distribution of *Capito auratus*, to show that the yellow-throated races are found at the periphery of the range of the species.

Y = yellow-throated races. R = red-throated races. O = orange-throated races.

example, expect to find a song sparrow on the northwest Pacific coast as pale as one from the Colorado Desert. In the group here reviewed, on the contrary, I repeatedly find individuals in the range of one form that cannot be distinguished from specimens of another and quite different form. We do not look for such wide variations in the song sparrows for, in the belief that their variations are caused by environment acting through climate, we do not expect similar influences to produce different results on the same organism at the same place. The fact, therefore, that the racial differentiations of *Capito auratus* are in large part covered by the range of variation at one place, and hence presumably under similar conditions, leads to the belief that these variations are not environmental but individual or mutational in nature. These variations affect the throat, crown, rump, flanks and abdomen.

VARIATIONS OF THE THROAT.—*Capito auratus* is differentiated primarily by the color and pattern of the throat. This may be loosely described as scarlet in three races, orange in three, and yellow in six. In one of the latter it is spotted with black. Between the extremes of color and pattern there is complete intergradation through individual variation. In every instance this variation appears to be retrogressive. That is, orange-throated individuals are found in the range and associated with a scarlet-throated race, yellow-throated individuals are found in series of the orange-throated races, and a spotless throated individual is found in the range of the spotted throat race. If these variants are atavistic they lead to the assumption that a yellow throat is more primitive than an orange one, that an orange throat preceded a red one, and that a spotted throat evolved from a spotless one.

VARIATIONS OF THE CROWN.—In the scarlet-throated species the crown varies from yellow-ochre or primuline to scarlet and these extremes are found at one locality. In the yellow-throated species the crown varies from analine-yellow to medal-bronze and this range of color may also be found at one locality. The orange-throated birds have the crown primuline or analine-yellow with, in some specimens, faint traces of red on the forehead. It is worthy of note that red is not found in the crown of a yellow-throated race but may be wholly wanting in the crown of a red-throated race.

VARIATIONS OF THE RUMP, FLANKS, AND ABDOMEN.—One-half the known races of *Capito auratus* are distinguished from their nearest allies by having the feathers of the rump margined, those of the flanks and abdomen washed with a deeper yellow than that on the forehead, upper tail-coverts and breast. The color of the rump is comparatively stable,

that of the flanks and abdomen less so than any other of the differentiating characters of the species.

UNFIXED VARIATIONS.—The series of *Capito auratus punctatus*, possibly because it is much larger than that of any other race, contains unique individuals showing marked variations. In one the throat is scaled, not spotted, in another the crown is brown, not yellow. These individuals illustrate the inherent tendency of the species to vary.

VARIATIONS IN SIZE.—*Capito auratus* presents but little individual and racial variation in size, only one of the twelve forms here recognized appears to differ from the others in this respect.

DISTRIBUTION

Capito auratus is an inhabitant of tree-tops and has well-developed powers of flight, but the narrow boundaries separating the ranges of many of the races well illustrate the sedentariness of most tropical birds. The race having the largest range is found at the base of the Andes, those having the smallest, inhabit the valley of the Amazon. The former occupies an area holding no effective barriers to range extension. There are no latitudinal mountain ranges and the rivers are too narrow materially to affect distribution.

The latter, on the other hand, inhabit a region where the rivers are broad enough to confine birds to one side or the other and they thus form an effective barrier to range extension.

In four instances opposite sides of the Amazon and Purus are occupied by different races of *Capito auratus*. On the Marañon, at the mouth of the Napo, *punctatus* is faced by *orosæ*; at Tonantins on the Solimões *nitidior* by *amazonicus* and at Manacaparú, *hypochondriacus* by *arimæ*; and on the Purus, *arimæ* by *novaolindæ*.

Taking the color of the throat as the most pronounced differentiating character affecting all the forms, it will be seen, from an examination of Figure 2, that the yellow-throated forms are all peripheral, while the orange- and red-throated birds are central. If, as has been suggested, the yellow-throated form is the more primitive, we have here an illustration of the type of distribution in which, according to the theory advanced by W. D. Matthew,¹ new forms originate at the center of dispersal, while the ancestral one is found at the outer limits of the range of the group. Hence it follows that closely related forms (e.g., *aurantiicinctus* and *insperatus*) may be widely separated.

¹1915, Ann. N. Y. Acad. Sci., XXIV, p. 180.

CONCLUSIONS

The conclusions reached support the thesis advanced. They may be briefly stated as follows:

Capito auratus varies widely in color and in pattern. The origin of these variations remains undetermined. In some instances they appear to be reversionary and indicate the route over which the form has travelled; in others they seem to be progressive, pointing the way to possible future development. All, however, may be characterized as individual or mutational rather than as geographic or climatic. The perpetuation of these variations as racial characters is directly related to the degree of isolation that the birds exhibiting them are afforded. At the base of the Andes, where the nature of the country fails to provide this isolation, forms are wide-ranging; in the valley of Amazonia, where broad rivers divide the heart of a continent into insular areas, the range of forms is correspondingly limited.

59.57,72 A (51)

NEW ASILIDÆ FROM CHINA (DIPTERA)

BY S. W. BROMLEY

A collection of Diptera from China, most of them from Yen-ping, received by the American Museum from Mr. R. H. Caldwell, contained a fine series of Asilidæ, among which were found the new species described in the present paper. The types are in The American Museum of Natural History.

***Microstylum vulcan*, new species**

Length, 33 to 42 mm. A large deep-black species with dark brown wings having a metallic greenish lustre. The last three abdominal segments are red, the legs are black, the mystax black and the beard yellow. Related to *M. oberthürrii* v. d. Wulp.

MALE.—Proboscis, mystax, palpi, palpal hairs, antennæ (first two segments; the rest missing), occipital bristles and bristles of vertex, black. Beard yellow. Thorax black, evidently grayish pollinose in fresh specimens. In the present specimen this is obscured for the most part by grease. Bristles and fine hairs of mesonotum black. Scutellum with black hairs and black marginal bristles. Legs black with black bristles and hairs. The middle tibiæ have at the apex on the under side a small projection which bears three or four short, stout spines. Front coxæ and propleura with yellow hairs, the front coxæ with black bristles intermingled. Pronotum with black bristles. Wings dark brown with metallic-green lustre. Abdomen black, venter with black hairs; fourth segment slightly reddish, the fifth to seventh deep red. Genitalia red with reddish hairs and a few blackish hairs.

FEMALE.—Similar, but the abdomen is thickly clothed with reddish hairs, the fifth to seventh segments are red contrasting strikingly with the first four which, however, appear somewhat reddish at the sides. There is a thick tuft of red hairs in front of the scutellum. All the coxæ have yellow hair and the hairs of the pleura are yellow. Spines of the ovipositor deep red, almost black.

Holotype: male, Yen-ping, China, August 8, 1917. Allotype and paratype female, same locality and date.

***Asilus mandarinus*, new species**

Length, 21 to 25 mm. A large yellowish species with yellowish-red legs and a few pale-yellow bristles on the posterior lateral margins of the abdominal segments. The wings are faintly tinged with yellowish, but grayish at the tip and along the posterior margin. The mesonotum bears a broad contrasting black median stripe and three dark lateral spots on each side.

MALE.—Eyes large, face narrow, covered with a pale yellowish-white pruinosity; facial gibbosity of medium size, but restricted to the area immediately above the oral margin. The mystax is composed of white hairs rather thickly covering the facial gibbosity but not extending to the base of the antennæ. Antennæ yellow, the arista black; antennal bristles yellowish, except a few on the upper side of the second segment which are black. Proboscis and palpi black, palpal hairs white. Beard white. Occiput pale yellowish-white pruinose; occipital bristles pale yellow. Thorax light yellowish-pruinose; all hairs of pleura pale yellowish-white; coxal hairs slightly darker. Pronotum black; mesonotum with a broad median black line bisected by a very narrow yellowish line which disappears anteriorly; three distinct black lateral spots on each side. Anterior portion of the mesonotum with short black hairs, posterior portion with long scattered yellow bristles. Scutellum light yellowish-brown pollinose with fine pale yellow hairs on disc and margin and with two long yellow bristles on the margin. Legs light yellowish-red, the dorsal portions of the femora very slightly darker; pulvilli pale yellow, claws black; anterior legs with scattered long yellow bristles, occurring most thickly on the underside of the femur and tibia; tarsi with yellow bristles and some black bristles below, the terminal joint slightly darker than the others. The median legs have the extreme tips of the femora black, a few yellow bristles on the underside of the femora and tibia, otherwise like the first pair. The posterior legs have the tips of the femora black, also, and the three distal joints of the tarsi are dark, the ultimate segment being black. All the femora are covered with minute black hairs. The wings are long and broad, nearly hyaline, but suffused with a pale yellowish tint, the apex and posterior borders gray. Halteres yellow. Abdomen dark brown with yellowish lateral and posterior margins to the segments. Genitalia shining black with yellow bristles, the forceps with two long slender processes on the upper apex, the anterior process being quite as long as the forceps themselves.

FEMALE.—Similar, the tarsi darker. The ovipositor short, conical, shining black; the cerci free.

Holotype: male, July 24, 1917. Allotype: female, June 28, 1917. Paratypes: male, June 26, 1917, two females, Aug. 14, and Sept. 1, 1917. All from Yen-ping, China.

***Asilus yenpingensis*, new species**

Length, 15 to 18 mm. Resembles *mandarinus* but is smaller, paler yellow, the third joint of the antenna is darker than the first two segments, both of which bear black bristles, and the genitalia are different. The median thoracic line is undivided and the scutellar bristles are black.

MALE.—Antennæ pale yellow, the third joint and arista darker, the first two segments with black bristles. Face yellowish pruinose. Mystax, beard and palpal hairs white, the occipital bristles dark brown. Palpi black. Thorax and legs yellow, the tips of the posterior femora and of all the tarsal segments blackish. Pleura and coxæ with pale yellow hairs. Mesonotum with black median line and two lateral black spots on each side, the hairs and bristles black. Scutellum yellow with fine black hairs on the disc and two black bristles on the margin. Wings hyaline, the apex and posterior borders gray. Halteres yellow. Abdomen yellow with yellow hairs and bristles. The base of the second tergite has a black area and the median portions of the following segments have brownish areas. Genitalia shining black with scattered long yellow and short black hairs, the forceps furcate with the prongs curved inward.

FEMALE.—Similar, the ovipositor short, conical, black with black hairs; the cerci free, light brownish.

Holotype: male, April 20, 1920. Allotype: female, April 6, 1920. Paratypes: male, May 20, 1920; five females, June 12, 1920 and May 31, 1920. All from Yen-ping, China.

***Asilus (Tolmerus) aurimystax*, new species**

Length, 18 to 20 mm. A blackish species with black legs, golden mystax (some black hairs in upper part), palpi with black hairs, scutellum with black hairs and bristles; genitalia rather long and narrow, the tops of the forceps slightly curved down.

MALE.—Head, including antennæ, proboscis, palpi, etc., black. Facial gibbosity rather prominent; face golden pruinose; mystax golden with some black hairs above. Beard pale yellow. Palpal hairs black. Antennal, vertical, and occipital bristles black. Pronotum with black bristles. Thorax black, yellowish-gray pollinose, with the usual black median line and lateral spots on mesonotum. Hairs and bristles of mesonotum and scutellum black; pleural and coxal hairs pale yellow. Legs black with bristles and most of hairs black; some pale hairs on front and median legs and the underside of the distal portion of the anterior and posterior tibiæ and tarsi is covered thickly with minute ferruginous hairs. Wings nearly hyaline with apex and interior of cells along posterior border gray. Halteres yellowish brown. Abdomen black, the lateral and the posterior margins narrowly yellowish-gray pollinose. Hairs and bristles of sides pale yellow; the fine hairs above, black. Genitalia shining black with black hairs, rather long (as long as the sixth to eighth tergites together), slender and pointed from dorsal view; from the side, the tips are slightly curved downwards. The eighth sternite is narrowly prolonged posteriorly and the process is covered with a thick tuft of black hair.

FEMALE.—Similar, ovipositor black, laterally compressed, slightly longer than segments six and seven.

Holotype: male, Aug. 10, 1917. Allotype: female, June 23, 1917. Paratype: female, Aug. 17, 1917. All from Yen-ping, China.

***Dysmachus tolmeroides*, new species**

Length, 22 mm. This species resembles the preceding very closely, but the lamella of the oviduct is wedged in. There are no bristles on the lamella, thus indicating classification with the *Eutolmus* group. It is a black species, yellowish-gray pollinose, with black legs and mystax.

FEMALE.—Facial gibbosity prominent, the antennæ (third segment lost), proboscis, palpi, palpal hairs, mystax, antennal bristles, bristles of vertex and of the occiput black. Beard pale yellow. A very few pale bristles in the mystax. Thorax yellowish-gray pollinose, with the usual black markings on the mesonotum. Hairs and bristles of mesonotum and scutellum black. Coxal hairs yellow; pleural hairs pale yellow. Legs black with black hairs and bristles; a few pale hairs on femora; Anterior and posterior tibiæ and tarsi with the underside thickly covered with minute ferruginous hairs. Wings hyaline with apex and interior of cells of posterior border gray. Halteres yellowish. Abdomen greased but apparently yellow-gray pollinose. The hairs and bristles along the sides are yellowish, the dorsal hairs black. The ovipositor is shining black, laterally compressed, longer than segments six and seven combined, the lamella wedged in.

Holotype: female, Yen-ping, China, July 6, 1917.

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BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. V.

BY ROBERT CUSHMAN MURPHY AND GREGORY M. MATHEWS

Identification of many of the forms listed in this paper had been undertaken by the senior author (Murphy), and the text dealing with the Sylviidæ of the Society and Marquesas Islands had been completed, when it was proposed that Mr. Mathews lend his services to a continuation of the study. Accordingly, a small selection of Polynesian Passeres was sent to England early during 1928, and Mr. Mathews has since given much time to the work. He has compared the American Museum material with the invaluable types and other pertinent specimens in British and continental museums, has made himself responsible for a combing of the literature, and has sent full notes to his co-author who has, in turn, extended the comparisons, measurements, and descriptions through the use of the larger series in the Whitney Expedition collection. For the final preparation of the manuscript the senior author is responsible.

Muscicapidæ

Pomarea nigra nigra (Sparrman)

Muscicapa nigra SPARRMAN, 1786, 'Mus. Carlson.,' fasc. 1, Pl. xxiii (Tahiti, Society Islands).

Society Flycatcher, LATHAM, 1787, 'Suppl. Gen. Synops. Birds,' pt. 1, p. 174 (Tahiti).

Muscicapa lutea GMELIN, 1789, 'Syst. Nat.,' I, pt. 2, p. 944, founded on "The Luteus Flycatcher" of LATHAM, 1783, 'Gen. Synops. Birds,' II, pt. 1, p. 342 (Tahiti).

Muscicapa atra FORSTER, 1844, 'Descr. Animal.,' edit. Lichtenstein, p. 170 (Tahiti).

ADULTS (sexes alike).—Entire plumage black, with a slight iridescence, except inner vanes of remiges and under surfaces of both wing and tail quills, which are somewhat fuscous and without gloss; shafts, lighter on the under surfaces of the quills, becoming whitish basally; concealed bases of the body feathers, dark grayish. Iris, dark brown; bill, light slaty blue; tongue and lining of mouth, blue; legs and feet, slaty blue, lightest on front of tarsus.

¹Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, and 322

MEASUREMENTS.—(5 males, 3 females): wing, 88-97; tail 70-77; exposed culmen, 16-17; bill from nostril, 11-12.3; tarsus, 26-27; middle toe with claw 19-20 mm.

RANGE.—Tahiti, Society Group.

Specimens from Tahiti, collected during December, 1920 and May, 1921.

Adults are uniform in appearance except that two among twelve specimens had bills prevailingly horn-colored, like those of the young. The juvenal plumage of the latter is well represented in our series of May birds. It ranges from cinnamon to tawny on the head, back, and flanks, lighter on throat and breast, and dirty white on the belly. The rectrices are tawny basally and fuscous-black distally. On the remiges the tawny hue is confined to the narrow outer webs. Over the rump of all specimens is a great spreading fan of fluffy black feathers.

The general cinnamon and tawny aspect, and even the nearly white appearance of the belly, are due entirely to the distal coloration of the juvenal feathers. The first black plumage is largely the result of wear; as the loss of the yellowish and whitish tips exposes the dark underlying portions of the feathers, the birds assume a motley of tawny and black, the latter element being reinforced by all black feathers succeeding the post-juvenal moult.

Notations regarding the gonads of such intermediate specimens indicate that the birds probably breed before assuming the immaculate black garb of full maturity. Among the adults there is nothing to show a correlation between season of the year and nesting time.

Measurements of the culmen, tarsus, and toe are somewhat unsatisfactory in birds of this group, scarcely any two workers deriving the same results. The length of the bill from the nostril is, however, likely to prove consistent, and as useful for comparison with larger or smaller subspecies as the dimensions of wing and tail.

***Pomarea mendosæ* (Hartlaub)**

Monarcha Mendosæ HARTLAUB, 1854, Journ. für Ornith., p. 170 (Tahuata Island, Marquesas Group).

SPECIFIC CHARACTERS.—Bill distinctly more compressed than in *Pomarea nigra*. Sexes unlike, the adult males resembling *nigra*, but with a higher iridescence; adult females, black and white, or black, white, and buff, in a pattern which varies distinctively among several geographic races; juvenal plumage, much darker than in *P. nigra*.

RANGE.—Tahuata, Hiva-oa, Motane, Huapu, and Nukuhiva Islands, Marquesas Archipelago.

Hartlaub proposed this species as a new name for the bird described by Forster on p. 172 of the 'Descr. Animal,' edit. Lichtenstein, 1844. The type was apparently not an adult, but its locality was fixed in *insula Sanctæ Christinæ seu Weitaho* (=Tahuata). On page 171 Forster lists it as *Muscicapa atra* (*M. nigra* of Sparrman, Linnæus, Gmelin, and Latham).

The typical race of the species is, therefore, *Pomarea mendozæ mendozæ* (Hartlaub.)

***Pomarea mendozæ mendozæ* (Hartlaub)**

SUBSPECIFIC CHARACTERS.—Adult female with black head and remiges, buffy ventral surface, white back, rump, and tail.

ADULT FEMALE.—Entire head, dull brownish black, intermingled on the throat with a few whitish feathers; back, scapulars, and rump, white, faintly blotched with grayish wherever the dark proximal parts of the feathers appear at the surface; tail, white, with variable brownish subterminal spots, and occasionally with a rectrix prevailing blackish brown on one or both webs; shafts of tail quills, dark dorsally, white below; ventral surface caudad from the throat, pale ochraceous-buff; primaries and their coverts, black, sometimes with whitish outer edgings; secondaries, black with broad white outer borders and terminations, these borders enlarging on the secondary coverts and the tertials; lining of wing, somewhat whitish. Iris, brown; bill, bluish; legs, bluish, with the feet nearly black.

NEOTYPE.—No. 196,143, Amer. Mus. Nat. Hist.; ♂ ad.; Tahuata Island, Marquesas; November 27, 1922; R. H. Beck.

MEASUREMENTS.—(10 males, 5 females, from Tahuata and Hivaoa): wing, 88–95; tail, 70–79; exposed culmen, 17.8; bill from nostril, 11.6–12.5; tarsus 28; middle toe with claw, 20–21 mm.

RANGE.—Tahuata and Hivaoa Islands, Marquesas.

Specimens from Tahuata collected during November, 1922, and from Hivaoa collected during September, 1902, January, 1921, and October and November, 1922.

To date, this has remained the only form of flycatcher described from the Marquesas, and it has usually been confused with the Tahitian species. In the absence of an existing type specimen, it would be preferable to select a female as the neotype but, unfortunately, we have no adult female from Tahuata. Comparison of males of all ages, and of young and semi-mature females, with an excellent series of specimens from Hivaoa shows that an identical race occupies these two neighboring islands.

Pomarea mendozæ mendozæ is of substantially the same size and proportions as the Tahitian *nigra*. The bill of *mendozæ* is, however, about one millimeter (13 per cent) narrower at the base, which gives it a more slender and rounded, and less flycatcher-like, aspect. Furthermore,

the metallic gloss of the black male is highly developed and is more definitely bluish or purplish than in *nigra*. Finally, in addition to the total dissimilarity of the females, the dorsal coloration of the immature stage of *mendozæ* is close to Prout's brown, with little of the bright ochraceous hue of young *nigra*, while the patch of fluffy black feathers, so characteristic of the lower back of *nigra*, is entirely lacking.

Plumage succession is as in the Tahitian species, and the extraordinarily mottled, black and rusty sub-adults breed in that stage.

The colors of soft parts in adult males are as recorded for the females. In young birds the mandible is described as yellowish or flesh-colored, the feet and legs as grayish or slate. Adults had gonads in various stages of development during all the seasons represented, and some are noted as nesting birds.

***Pomarea mendozæ motanensis*, new subspecies**

SUBSPECIFIC CHARACTERS.—Closely resembling *Pomarea mendozæ mendozæ* but slightly larger; females with fewer and smaller subterminal spots on the rectrices; juvenal plumage lighter and brighter, especially on back and tail (russet instead of Prout's brown).

TYPE.—No. 196,087, Amer. Mus. Nat. Hist.; ♂ ad.; Motane Island, Marquesas; November 22, 1922; R. H. Beck.

MEASUREMENTS.—(20 males and females): wing, 94-103; tail, 74-80; exposed culmen, 18-20; bill from nostril, 13-13.8; tarsus, 27.5-28.6; middle toe with claw, 20-21 mm.

RANGE.—Motane Island, Marquesas.

Specimens from Motane collected during November, 1922.

This race is nearly identical in appearance with that of *Hivaoa* and *Tahuata*, the differences apparent to a casual glance showing only in juvenals. It is, however, slightly but uniformly larger than the typical race, especially in the size of the bill and the length of the wing.

Some of the adults were caring for young during November. A nestling not ready for flight, and much darker in general tone than the active juvenals, was collected on November 22.

***Pomarea mendozæ mira*, new subspecies**

SUBSPECIFIC CHARACTERS.—Larger than *Pomarea mendozæ motanensis*. Males of these two forms of similar appearance, but females totally unlike; adult female of *mira* uniform black save for a white tail and a white area covering the proximal two-thirds of the wing. Juvenal plumage duller and lighter than in either of the two preceding subspecies.

ADULT FEMALE.—Entire plumage, except that of wings and tail, black, slightly glossy, though less so than in the male; tail, including quill-shafts, white, a few small

and faint brownish blotches and speckles scattered irregularly on the rectrices of some specimens; upper and under tail coverts, basally black, terminally white; remiges, proximally white, distally clove brown, the white wing-patch extending progressively nearer the tips of the feathers toward the inner wing, the middle quills being solidly brown for nearly half their length, the inner quills for less; shafts of all the remiges, black; secondaries edged with white clear around their tips, enclosing a large brown spot; tertials entirely white on their outer webs, with a single brown subterminal spot on the inner web; secondary greater coverts, white; primary coverts, middle coverts, and marginals, mostly black. Colors of soft parts as in the preceding forms.

TYPE.—No. 195,881, Amer. Mus. Nat. Hist.; ♀ ad.; Huapu Island, Marquesas; November 2, 1922; R. H. Beck.

MEASUREMENTS.—(10 males, 5 females): wing, 102-109; tail, 78-84; exposed culmen, 18.5-20; bill from nostril, 13-14.6; tarsus, 30-32; middle toe with claw, 20.5-22 mm.

RANGE.—Huapu Island, Marquesas.

Specimens from Huapu collected during October, 1921, and September and November, 1922.

Adult males resemble those of the preceding races of this species, except for their slightly larger size and the fact that the blue iridescence of the black plumage is more pronounced on the belly than in the other forms. The under sides of wing and tail quills have a purplish sheen. Adult females, as would appear from the description, are absolutely distinctive. The juvenal coloration is duller and lighter than in *P. m. mendozæ* or *P. m. motanensis*, the general tone being close to Benzo brown on the dorsal surface and light cinnamon-drab on the ventral.

Plumage succession is characteristic of the species. The tail quills of females, after completion of the post-juvenal moult, are grayish and brownish, with only restricted areas of white. Subsequent rectrices come in nearly or quite immaculate. The first feathers that show the outlines of the large wing-patch are likewise heavily tinged with brown and rufous, at least two moults preceding the pure white stage of maturity.

***Pomarea mendozæ nukuhivæ*, new subspecies**

SUBSPECIFIC CHARACTERS.—Male practically indistinguishable from that of *Pomarea mendozæ mendozæ*. Female somewhat resembling the much larger female of *P. m. mira*, but differing in that the entire mantle, lower belly, and crissum are pure white.

ADULT FEMALE.—Head, nape, breast, belly, upper flanks, and thighs, black, with a slight iridescence on pileum and throat; feathers of belly more or less bordered with white in fresh plumage, giving a mixed appearance; back scapulars, rump, lower flanks, vent, crissum, and tail, including both upper and under coverts, white; remiges, clove brown, crossed by a large white wing-patch of practically identical pattern with that of *Pomarea mendozæ mira*. Iris, "light brown"; bill, bluish slate; legs bluish slate, with the feet black.

TYPE.—No. 195,991, Amer. Mus. Nat. Hist.; ♀ ad.; Nukuhiva Island, Marquesas; October 19, 1922; E. H. Quayle.

MEASUREMENTS.—(8 males, 5 females): wing, 90–96; tail, 75–80; exposed culmen, 18–19; bill from nostril 12–13; tarsus, 27.5–29; middle toe with claw, 19–20 mm.

RANGE.—Nukuhiva Island, Marquesas.

Specimens from Nukuhiva collected during September and October, 1922; also two females in the British Museum.

Nothing but locality could be invoked to identify the glossy blue-black males of this race with certainty. Fortunately, the females are striking and unmistakable.

The early fledgling plumage, as represented by a bird taken from the nest on October 19, is surprisingly dark (close to mummy brown on head and back). This agrees with the same stage in certain of the other races. Only later, after the young have left the nest, does the juvenal garb become distinctive. Immature specimens of *nukuhivæ* are considerably brighter in hue than those of *mira*, showing some rufescence on forehead, breast, back, and flanks. They are, however, less richly colored than the young of the other subspecies. Birds of intermediate age show more or less white in the tail and on the mantle simultaneously with the appearance of scattered black feathers on the head and breast.

***Pomarea iphis*, new species**

SPECIFIC CHARACTERS.—Sexes unlike, the females retaining a plumage of the juvenal type, the males exhibiting a black and white garb which resembles the female pattern of two or more races of *Pomarea mendozae*.

RANGE.—Huahuna (Uahuka) and Eiao (Eiau) Islands, Marquesas Archipelago.

The type of the species is *Pomarea iphis iphis*.

***Pomarea iphis iphis*, new subspecies**

SUBSPECIFIC CHARACTERS.—Adult male iridescent black, save for the wing and tail quills, which are brown, the breast and belly which are black and white, and the under tail coverts which are entirely white.

ADULT MALE.—Head, back, rump, upper tail coverts and chest, black, with an iridescence which is greenish rather than bluish; chin and interramal feathers, without gloss; quills, fuscous, the secondaries and, more especially, the rectrices, overlaid with a dark greenish gloss; wing coverts, black with a narrow glossy border on each feather; lower breast, belly, and flanks covered with mixed white and dull black feathers, giving a coarsely mottled aspect which is individually variable, some specimens being previlingly black on the belly, others previlingly white; under tail coverts, white, with dark gray bases; scattered white feathers in the throat, auriculars, scapulars, back, wing coverts, or secondaries of some specimens. Iris, brown; bill, black, with a bluish tone near the base; legs and feet, slaty black.

ADULT FEMALE.—Pileum and nape, olive-brown, with a few interspersed black feathers on the forehead and crown, and around the eye; back, scapulars, rump, and upper tail coverts, cinnamon-brown; quills, olive-brown, with narrow tawny outer margins, whitish inner margins on the rectrices, and whitish inner and terminal margins on the secondaries; wing coverts, olive-brown, with broad tawny margins and tips; ventral surface, whitish, streaked with black on throat and cheeks, and tinged with tawny on flanks, sides of breast, and crissum; lining of wing, whitish. Flesh colors, as in the male.

TYPE.—No. 196,041, Amer. Mus. Nat. Hist.; ♂ ad.; Huahuna Island, Marquesas; November 16, 1922; E. H. Quayle.

MEASUREMENTS.—(9 males, 6 females): wing, 90–96; tail, 72–81; exposed culmen, 17; bill from nostril 11–11.8; tarsus, 27–28; middle toe with claw, 18–19 mm.

RANGE.—Huahuna Island, Marquesas.

Specimens from Huahuna collected during October and November, 1922.

Juvenals resemble adult females save for the absence of dark streaking on head and throat. The transformation to the mature male plumage begins at the forehead and chin, the glossy black feathering working progressively caudad. The tail quills that succeed the post-juvinal moult still show considerable white, while olive-brown feathers persist for a long time on the lower back and rump. In this mixed plumage the birds breed, and doubtless the assumption of the final type of mature dress comes only after a post-nuptial moult.

***Pomarea iphis fluxa*, new subspecies**

SUBSPECIFIC CHARACTERS.—Smaller than *Pomarea iphis iphis*; white or white-mottled areas of the male much more extensive, including the breast, flanks, mantle, and lateral rectrices; only a faint gloss on any part of the black plumage; female with speckled throat and chest.

ADULT MALE.—Head, nape, chest, upper and under tail coverts, black, with a very slight iridescence; wings, including quills and coverts, sooty black; central rectrices, sooty black and slightly glossy, the outermost one or two pairs of rectrices usually white, though this condition is highly variable, some specimens having no more than a single white quill in the tail while others have all but the two central pairs white; back, scapulars, rump, breast, belly, and flanks, covered with mixed black and white feathers, giving a blotched appearance which is variable in the degree of prevailing whiteness or blackness; in a few specimens scattered white feathers extend cephalad in the black plumage to the chin and lores. Iris, brown; bill, black, bluish at base and on mandible; legs and feet, black.

ADULT FEMALE.—Resembling that of *Pomarea iphis iphis*, but lighter on the back, many of the tawny-olive feathers having whitish tips; more speckled on throat and chest, and more buffy on the whole ventral surface. Ventral speckling is still more pronounced in the juvenal stage of both sexes, and the dorsal surface is darker than in the adult female.

TYPE.—No. 195,919, Amer. Mus. Nat. Hist.; ♂ ad.; Eiao Island, Marquesas; September 27, 1922; R. H. Beck.

MEASUREMENTS.—(7 males, 5 females): wing, 79–86; tail, 69–77; exposed culmen, 14.5–16; bill from nostril, 10–10.8; tarsus, 26–27; middle toe with claw, 16.5–18 mm.

RANGE.—Eiao Island, Marquesas.

Specimens from Eiao, collected during September and October, 1922.

This race is characterized by small size and a short wing in addition to the peculiar and somewhat unstable pattern of its plumage. The primary formula is as in other forms of *Pomarea*, but the wing is perhaps more rounded than in any other Marquesan race, the third, fourth, fifth, and sixth primaries from the small outermost quill being subequal in length.

Plumage sequence is characteristic of the group. Juvenal males show a fine blotching or mottling on the ventral surface before white feathers have appeared on the back, and in this stage their outer rectrices are merely tipped with white spots or mottled with white. The entirely white quills appear after another moult.

***Pomarea whitneyi*, new species**

SPECIFIC CHARACTERS.—Size very large; sexes alike, black.

ADULTS.—Plumage black, with dark purplish-blue iridescence on head, dorsum, and under surface as far caudad as the belly; on the wing coverts the iridescence is confined to a narrow margin on each feather, and on the remiges and rectrices to the outer border of each quill, save the outermost few primaries, which are dull; under side of quill-shafts, horny, whitish toward the base; under surfaces of quills with a glossy purplish sheen, though without iridescence; feathers of forehead and lores strongly antrorse, those of the throat and mentum slightly so and interspersed with fine filoplume bristles. Iris, brown; bill, "bluish horn"; legs, dark bluish gray, with the feet black.

TYPE.—No. 195,808, Amer. Mus. Nat. Hist.; ♂ ad.; Fatuhiva Island, Marquesas; December 6, 1922; R. H. Beck.

MEASUREMENTS.—(10 males and females): wing, 110–118 (113.7); tail, 97–105 (101.5); exposed culmen, 21–22; bill from nostril, 14.5–16 (15.3); tarsus, 32–33; middle toe with claw, 22–24 mm.

RANGE.—Fatuhiva Island, Marquesas.

Specimens from Fatuhiva collected during December, 1922.

This handsome species, the giant of the genus, is named in honor of Mr. Harry Payne Whitney, patron of the American Museum's work in Pacific ornithology.

Adults had gonads in all stages of development during December, and some are marked as nesting birds.

The plumage sequence of immature specimens resembles that among the other forms of *Pomarea* found at the Society and Marquesas Islands. A beautifully graded series of skins shows the progressive replacement of the buffy and whitish first plumage by black feathers.

Juvenals are prevaillingly cinnamon-brown dorsally, darker and grayer on the crown and quills. The auricular region, sides of neck and breast, wing coverts, outer margins of remiges, and the crissum, are sayal brown, with scattered feathers of the same color throughout the whitish ventral surface. As among other Marquesan forms, nestlings are darker than the active juvenals, the subsequent change of shade being apparently due to wear and fading.

Sylviidæ

***Conopoderas caffa caffa* (Sparrrnan)**

Sitta caffa SPARRMAN, 1786, 'Mus. Carlson.,' fasc. I, No. 4, Pl. iv (no locality indicated = Tahiti).

Tatare fuscus LESSON, 1842, Rev. Zool., V, p. 210 (Tahiti).

Tatare longirostris, SHARPE, 1883, 'Cat. Birds Brit. Mus.,' VII, p. 525 (part).

Tatare caffer, OBERHOLSER, 1905, Proc. U. S. Nat. Mus., XXVIII, p. 900.

Conopoderas caffa, WETMORE, 1919, Bull. Mus. Comp. Zool., LXIII, No. 4, p. 206.

Specimens from Tahiti, collected during December 1920, August, 1921, July, 1922, and January, 1923.

Sharpe's description of the normal phase of this warbler, in the 'Catalogue of Birds,' was evidently based upon Tahitian specimens and is applicable to the American Museum series. The "brown" of the dorsal surface approximates the dark olive of Ridgway's 'Color Standards and Nomenclature,' while the yellow of the belly, throat and superciliary stripe matches the primrose yellow of the same authority.

According to the collector's labels, the iris was brown, the bill horny brown above and flesh color on the mandible, the inside of the mouth orange, the feet and legs greenish slate.

The dark phase, which has been described by Lesson as *Tatare fuscus*, is represented by a female dated Dec. 2, 1920, and a male dated Aug. 12, 1921. In common with other August specimens, the latter had enlarged gonads. In these birds the entire plumage, including concealed parts of the feathers, is brown, the color of the dorsal surface being close to clove brown, a few feathers of the back and scapulars showing faintly paler edgings. The ventral surface, from throat to tail coverts, is tinged with a lighter and warmer hue which ranges from cinnamon-brown to sepia. The female has a patch of normal yellow feathers in the inter-

ramal space. The bill is blackish on the maxilla, dark brown on the mandible.

Tristram believed that the plumage just described represents the normal immature stage of the Tahitian form. He wrote (Ibis, 1883, p. 43), "According to the specimens in the Bremen Museum, the young of the Society Island species are of a uniform very dark brown, strangely unlike the coloration of the adult, and with no trace of yellow in their plumage." If the Bremen birds are actual nestlings, this supposition may be correct. Unfortunately, the American Museum series does not settle this point with finality. Since one of our brown birds was in breeding condition, however, we suspect that the plumage more probably represents a phase than an age, but the matter needs further investigation.

Albinism is a chronic tendency among several forms of *Conopoderas*, and it would be interesting to find the converse condition of pigmentation. If this should prove to be represented by our two Tahitian examples, it may be described as intermediate between erythrism and melanism.

As noted above, August specimens were mostly in breeding condition. The moult comes later in the year, many December birds showing renewal of the wing and tail quills.

Tahiti comprises the known range of the *forma typica*, for the supposedly synonymous *Turdus longirostris* of Gmelin, described from the neighboring island of Eimeo or Moorea, proves to be a distinct subspecies.

MEASUREMENTS.—(5 males, 4 of normal and 1 of dark phases [10 specimens for length of wing and tail]): wing, 94-100 (96.9); tail, 73-81 (78.3); exposed culmen, 25-28 (27.1); bill from nostril, 20-21.5 (20.8); tarsus, 30-32 (31.4) mm.

5 females: wing, 92-95 (93.4); tail, 72-76 (74.4); exposed culmen, 26-27 (26.6); bill from nostril, 19.5-21 (20.5); tarsus, 29.6-31 (30.2) mm.

***Conopoderas caffa longirostris* (Gmelin)**

Turdus longirostris GMELIN, 1789, 'Syst. Nat.,' I, pt. 2, p. 823 (Moorea, Society Islands).

SUBSPECIFIC CHARACTERS.—Similar to *Conopoderas caffa caffa*, but larger in all dimensions except length of tarsus; tail, excepting the central pair of rectrices, prevailing yellowish-white.

ADULTS (sexes alike).—Pileum, hind neck, back, scapulars and upper tail coverts dark olive, the feathers margined with yellowish, narrowly on forehead and hind neck, least on the crown, but with increasing breadth toward the base of the rump, which is prevailing straw yellow; rectrices clove brown, the primaries narrowly margined with yellowish on their outer webs and slightly tipped with white; innermost primary and the secondaries more broadly tipped with creamy white which extends proximally

along the edges of both webs in some instances for half the length of the feathers; wing coverts clove brown, broadly margined with barium yellow, several of the feathers in one specimen being mostly of the latter color which pales toward the tips; bend of wing, barium yellow; central pair of rectrices clove brown, tipped with creamy white; the remaining tail quills creamy white both above and below, slightly more yellowish on their outer webs and with irregular clove brown blotches on both vanes of one or more feathers; lower eyelid, a narrow superciliary stripe, lores, cheeks and entire ventral surface, including under wing and tail coverts, yellow (barium yellow at areas of maximum intensity), the cheeks, lores, sides of breast and lower flanks invaded somewhat by dark olive feathers similar to those of the dorsal plumage; under surface of rectrices mouse gray, paler toward the bases and slightly tinged with yellowish on the outer webs of the feathers. Iris, "olive brown"; bill, horny above, flesh color on mandible; feet and legs, "slate."

MEASUREMENTS.—(2 males, 1 female): wing, 103–106 (104.3); tail, 85–90 (88); exposed culmen, 29–30 (29.3); bill from nostril, 22.3–23.5 (22.9); tarsus, 30–32 (31) mm.

RANGE.—Moorea Island, Society Group.

Three specimens from Moorea, Aug. 5 and Oct. 28, 1921; collected by E. H. Quayle.

The outstanding distinction between this race and that of Tahiti lies in the length of the tail, although *longirostris* is also larger in general proportions. Because of the uncertainty attending the measurement of the "exposed culmen" in this group, as in the genus *Pomarea*, we have included also the dimension "bill from nostril," which permits a more satisfactory comparison of bill length.

***Conopoderas caffa percernis* Wetmore**

Conopoderas percernis WETMORE, 1919, Bull. Mus. Comp. Zoöl., LXIII, No. 4, p. 213 (Nukuhiva, Marquesas Islands).

SUBSPECIFIC CHARACTERS.—Differs from *Conopoderas caffa caffa* as follows: entire plumage suffused with a deeper and richer yellow; inner margins of primaries, in ventral aspect, white instead of buffy; wing and tail slightly longer; bill decidedly shorter and slightly stouter, with the curve of the culmen more pronounced.

MEASUREMENTS.—(5 males [10 for length of wing, tail, and bill from nostril]): wing, 98.103 (100.6); tail, 81.6–87 (85); exposed culmen, 22–24 (23); bill from nostril, 17–18.2 (17.9); tarsus, 31.5–32.6 (31.9) mm.

5 females: wing, 95–102 (98); tail, 79–86 (82.1); exposed culmen, 23–24.2 (23.5); bill from nostril, 18–19 (18.2); tarsus, 31–33 (31.8) mm.

RANGE.—Nukuhiva Island, Marquesas Group.

Specimens from Nukuhiva, collected by R. H. Beck and his associates during September and October, 1921, and September, October, and November, 1922; also specimens from the Bishop Museum dated May, 1902.

This form was described with characteristic fullness and accuracy

by Wetmore. With his account the more extensive American Museum material closely agrees. The whiteness of the center of the abdomen, however, is not conspicuous, being confined to the basal parts of the feathers and mostly concealed by the yellow tips. The condition of moult, and the state of the gonads vary greatly and seem to have little relation to the dates of capture. Colors of soft parts, as recorded on the labels, are as follows: iris, brown; bill, blackish brown above, horny or flesh color below; feet grayish or slaty.

Treatment of the Marquesan warblers as races of *Conopoderas caffa* seems to be most in accordance with the indicated facts of distribution and evolution. The birds of the Society and Marquesas islands are obviously representative forms, one of another, and their distinguishing characters are of subspecific degree.

***Conopoderas caffa mendanæ* (Tristram)**

Acrocephalus mendanæ TRISTRAM, 1883, Ibis, p. 43, Pl. 1, ("Marquesas Islands" = Hivaoa or Tahuata, Islands, Marquesas).

Tatara mendanæ, SHARPE, 1883, 'Cat. Birds Brit. Mus.,' VII, p. 526.

Conopoderas mendanæ, WETMORE, 1919, Bull. Mus. Comp. Zool., LXIII, No. 4, p. 213.

SUBSPECIFIC CHARACTERS.—Similar to *Conopoderas caffa percernis*, but of distinctly paler yellow coloration on the entire ventral surface and on the feather borders of the dorsal plumage.

MEASUREMENTS.—(5 males from Hivaoa [10 for length of wing, tail, and bill from nostril]: wing, 96.6–102 (99); tail, 79–84 (82); exposed culmen, 23–24.8 (24); bill from nostril, 17.7–19.8 (19); tarsus, 31.3–33 (32.1) mm.

5 females from Hivaoa: wing, 94–102 (97.3); tail, 77–92 (79.8); exposed culmen, 23–24.6 (23.8); bill from nostril, 18.7–20 (19.2); tarsus, 30.5–33 (31.3) mm.

5 males from Tahuata (10 for length of wing, tail, and bill from nostril): wing, 97–102 (99.7); tail, 80.6–85 (83); exposed culmen, 23–24 (23.5); bill from nostril, 18.5–19.8 (19); tarsus, 31.7–32.5 (32) mm.

5 females from Tahuata: wing, 95.5–100 (96.6); tail, 78–84.6 (79.3); exposed culmen, 23–24.3 (23.8); bill from nostril, 18.6–19.9 (19.1); tarsus, 30–31.2 (30.7) mm.

RANGE.—Hivaoa and Tahuata Islands, Marquesas.

Specimens from Hivaoa collected during January and October, 1921, and October and November, 1922. Specimens from Tahuata, November, 1922. Hivaoa is here designated the type locality.

This form was not rediscovered, after the time of Tristram's original publication, until the Whitney Expedition collections were received at the American Museum. No particular island of the Marquesas was cited by Tristram, and neither his plate nor his textual description could be made to match any Marquesan warblers subsequently studied. Thus

Wetmore, in proposing the name *Conopoderas percernis* for the bird of Nukuhiva, pointed out a difference in coloration of the rectrices between skins of *percernis* and the colored plate of *mandanæ*.

Our warblers from Hivaoa, Tahuata, Fatuhiva, Motane, Huapu, Huahuna, Nukuhiva, Eiao, and Hatutu Islands agreed no better with the plate, but when specimens were compared by the junior author with Tristram's type skins, the latter were found to be identical with birds from the closely adjacent islands of Hivaoa and Tahuata. The discrepancies of the plate may, therefore, be charged against the artist.

The differences between the forms *percernis* and *mandanæ* are such as would not seem impressive if single skins of each were laid side by side. When long series are juxtaposed, however, the contrast is striking enough to be instantly apparent. In *percernis* the brighter areas of the cheeks, throat, and breast are citron yellow, or of even a slightly richer hue. In *mandanæ* the same regions are much less vivid, approximating baryta or straw yellow. The differences show particularly well when the throat and malar areas of the two insular races are compared. In dorsal aspect, *percernis* is a consistently "greener" bird.

C. c. mandanæ is, in fact, closer in appearance to the Tahitian race than is *percernis*. It is distinguishable, however, both by its proportions and by the whiteness of the inner margins of the primaries as seen from below.

Flesh colors, according to the labels, are as recorded for *percernis*.

***Conopoderas caffa consobrina*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Conopoderas caffa mandanæ* but averaging slightly smaller, particularly in the length of the bill; yellow of ventral surface slightly more intense, and dorsal feathers with broader yellowish margins.

TYPE.—No. 195,481, Amer. Mus. Nat. Hist.; ♂ ad.; Motane Island, Marquesas Group; November 22, 1922; R. H. Beck.

MEASUREMENTS.—(5 males [10 for length of wing, tail, and bill from nostril]): wing, 94.4–99 (96.8); tail, 77.5–84 (80.8); exposed culmen, 21–22.7 (21.8); bill from nostril, 16.–17.8 (17); tarsus, 31.4–31.7 (31.6) mm.

5 females: wing, 92–98 (95.1); tail, 78–84 (80.3); exposed culmen, 20.5–22 (21.2); bill from nostril, 15.5–17.3 (16.4); tarsus, 29.5–31.1 (30.2) mm.

RANGE.—Motane Island, Marquesas

Specimens from Motane collected during November, 1922.

This subspecies is compared with *mandanæ*, rather than with *percernis*, because it appears to be very close to the warbler of Hivaoa and Tahuata. Motane lies ten to twelve miles from the nearest points of its two neighboring islands, and about twenty-five miles from the next near-

est island, which is Fatuhiva. The conditions parallel those exhibited by the resident forms of *Pomarea*. *Conopoderas caffra consobrina* bears the same relation to *Conopoderas caffra mendanæ*, of Hivaoa and Tahuata, that *Pomarea mendozæ motanensis* does to *Pomarea mendozæ mendozæ*, which likewise inhabits Hivaoa and Tahuata. Both the warbler and the flycatcher of Motane may be described as distinct though "weak" geographic races, i. e., weak when compared with the highly distinctive forms inhabiting Fatuhiva and some of the other islands.

The differences between *consobrina* and *mendanæ* can best be seen in dorsal aspect, the former being perceptibly "yellower." Similar differences in hue crop up among other Marquesan forms, as will appear under the consideration of the warblers inhabiting Huapu, Eiao, and Hatutu.

Among all races of *Conopoderas*, males average somewhat larger than females, a condition apparently not obtaining in the genus *Pomarea*. The sexual discrepancy should be noted when measurements are compared.

Several of the Motane specimens are labeled "nesting." A fledgling taken on November 22 is dark olive gray on the back, with faint yellowish terminal margins on some of the feathers. The under surface is creamy white, tinged with yellow on chin, breast, and belly.

***Conopoderas caffra fatuhivæ*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Conopoderas caffra percernis*, but with a longer bill and tarsus, brighter and more extensive yellow coloration on the rump, and paler feet and legs.

TYPE.—No. 195,588 Amer. Mus. Nat. Hist.; ♂ ad.; Fatuhiva Island, Marquesas Group; November 30, 1922; R. H. Beck.

MEASUREMENTS.—(5 males [10 for length of wing, tail, and bill from nostril]): wing, 95.5–101 (98.4); tail, 80–89 (83.7); exposed culmen, 24.5–25.7 (25); bill from nostril, 19–20.8 (20); tarsus, 32.6–34 (33.1) mm.

5 females: wing, 93–96.5 (94.8); tail, 79–83.4 (80.9); exposed culmen, 23.6–26 (24.9); bill from nostril, 18.2–21 (19.7); tarsus, 31–33 (32.1) mm.

RANGE.—Fatuhiva Island, Marquesas.

Specimens from Fatuhiva collected during November and December, 1922.

The warbler of Fatuhiva has the longest bill of any of the Marquesan subspecies. Among fifteen measured specimens, the minimum length of the exposed culmen, and the minimum distance between the anterior end of the nostril and the tip of the maxilla, are about equal, respectively, to the maxima of these dimensions among thirty examples of *Conopoderas caffra mendanæ*, which has the next largest bill.

In the general brightness of the yellow underparts, *fatuhivæ* agrees with *percernis* of Nukuhiva rather than with its nearer neighbor on the islands of Hivaoa and Tahuata. In dorsal aspect, however, *fatuhivæ* is at once distinguishable from either *percernis* or *mendanæ* by the extensive yellow area of the rump and greater part of the upper tail coverts. This region, which ranges in color from straw yellow to colonial buff, forms a continuous area with the flanks and crissum, practically without admixture of olivaceous feathers. The plumage of the back is more broadly margined with yellow than in either *percernis* or *mendanæ*, making *fatuhivæ* appear less green. The inner borders of the primaries, seen from beneath, are not white as in the two preceding races, but are distinctly tinged with yellowish.

The above descriptive remarks apply to specimens in fresh plumage. Wear and fading produce marked changes in general appearance, causing the back to turn brownish as the yellow feather-borders disintegrate, while the rump and ventral surfaces pale notably.

In contrast with the nestling plumage of *C. c. percernis*, that of *fatuhivæ* is quite unlike the adult state. As illustrated by three specimens collected on December 6 to 8, 1922, juvenals are of a color intermediate between buffy brown and olive-brown on the dorsal surface, the feathers of the interscapular region showing whitish borders and those of the lower back rufescent borders. On the under surface the plumage is creamy white, slightly tinged with yellowish on the breast and with buffy on belly, flanks, and crissum. Through a complete post-juvinal moult, this plumage is succeeded by that of maturity.

Every condition with reference to feather replacement and the breeding period seems to be represented among birds taken contemporaneously. Colors of soft parts are as in the preceding subspecies, except that the feet and legs are usually described as "grayish" or "whitish," an indication of lighter coloration that is apparent in the dried skins.

***Conopoderas caffa idæ*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Conopoderas caffa percernis*, but smaller in all dimensions, and with a particularly short and slender bill.

TYPE.—No. 195,504, Amer. Mus. Nat. Hist.; ♂ ad.; Huahuna Island, Marquesas Group; November 9, 1922; R. H. Beck.

MEASUREMENTS.—(5 males [10 for length of wing, tail, and bill from nostril]): wing, 85–93 (89.3); tail, 73–81.7 (77.1); exposed culmen, 18–19.6 (19); bill from nostril, 14.4–16.1 (15.1); tarsus, 29.2–31 (30.1) mm.

5 females: wing, 85–91 (88.4); tail, 73–79 (75.2); exposed culmen, 18–19.5 (18.7); bill from nostril, 13.8–15.8 (15); tarsus, 29.5–29.8 (29.6) mm.

RANGE.—Huahuna (Uahuka) Island, Marquesas.

Specimens from Huahuna collected during November, 1922.

Small size, particularly obvious in the bill, is the only apparent character of the warbler inhabiting the island of Huahuna. It is the smallest of all the Marquesan subspecies. In general coloration it agrees with *percernis* rather than with *mendanæ*, but the maximum lengths of the wing, culmen, bill from nostril, and tarsus, in a representative series, are less than the respective minima among the two other races.

Birds in various stages of plumage, some with small and some with enlarged gonads, were collected together during the month of November.

Juvenals resemble the young of *percernis*, being well tinged with yellow on the ventral surface. The back, however, is less greenish, the prevailing color being hair brown with scarcely perceptible lighter margins on the feathers.

Field labels record the colors of soft parts as in the other forms except that the legs are described as "greenish slate."

We take pleasure in naming this subspecies in honor of Ida M. (Mrs. Rollo H.) Beck, who has accompanied her husband during the greater part of his Polynesian travels.

***Conopoderas caffa dido*, new subspecies**

SUBSPECIFIC CHARACTERS.—Larger than *Conopoderas caffa idæ*, particularly in the size of the bill; smaller than the subspecies *mendanæ* and *percernis*: in coloration most closely resembling *percernis*, but the yellow of the ventral surface is even more intense, being strontian yellow, rather than citron-yellow, on the throats and breasts of specimens in fresh plumage.

TYPE.—No. 190,460, Amer. Mus. Nat. Hist.; ♂ ad.; Huapu Island, Marquesas Group; October 3, 1921; R. H. Beck.

MEASUREMENTS (5 males [10 for length of wing, tail, and bill from nostril]); wing, 91.5-96 (93.8); tail, 77-82 (79.3); exposed culmen, 21.6-22.6 (21.9); bill from nostril, 16.1-17.3 (16.8); tarsus, 29.5-31 (30.2 mm.).

5 females: wing, 88-95 (91.1); tail, 72.7-80 (76); exposed culmen, 20.7-22 (21.1); bill from nostril, 15.5-17.3 (16.5); tarsus, 28.2-30.2 (29.3) mm.

RANGE.—Huapu (Uapu or Uapa) Island, Marquesas.

Specimens from Huapu collected during October, 1921 and September and November, 1922.

The warbler of Huapu is the brightest of all the subspecies in the color of the breast, and is readily distinguishable from any of the Marquesan insular forms thus far described in this paper. When compared with those which follow, it must be confessed that the systematist is hard put to find words through which the slight though constant differences can be made to appear tangible. Variation in size among the remaining forms

is slight, and variation in color is sometimes hard to see except when series of ten or more skins from each of the several islands are laid side by side. Under the latter circumstances, however, slight distinguishing characteristics, coupled with separate insular ranges, are made discernible, and the taxonomic procedure becomes clearly indicated. We are witnesses of actual biological differences between isolated colonies of closely related organisms. The differences may, indeed, be far wider and deeper than the clothing of the dead skins reveals. Whether or not the phenomena are associated with the beginning of speciation, there is no course but to give each of the entities a name.

Descriptive notes on the flesh colors of *Conopoderas caffa dido*, and of the forms that follow, are the same as those upon the labels of *percernis*.

***Conopoderas caffa aquilonis*, new subspecies**

SUBSPECIFIC CHARACTERS.—Resembling *Conopoderas caffa dido*, of Huapu Island, but with slightly less intense yellow coloration on the ventral surface, and with a smaller bill; larger in all dimensions than the subspecies *idæ*, of Huahuna Island.

TYPE.—No. 195,357, Amer. Mus. Nat. Hist.; ♂ ad.; Eiao Island, Marquesas Group; October 2, 1922; R. H. Beck.

MEASUREMENTS.—(5 males [10 for length of wing, tail, and bill from nostril]): wing, 91-96 (93.6); tail, 77.5-84 (80.8); exposed culmen, 19.2-20.2 (19.8); bill from nostril, 14.4-16 (15.4); tarsus, 30.5-31.3 (30.8) mm.

5 females: wing, 87.5-98 (91.9); tail, 74-83 (77.8); exposed culmen, 20-20.5 (20.2); bill from nostril, 15-16.2 (15.8); tarsus, 29-31.2 (30.1) mm.

RANGE.—Eiao (Eiau) Island, Marquesas.

Specimens from Eiao collected during September and October, 1922.

With reference to this form, there is little to add to the description. Adults had gonads in every stage of development, but no specimen in the series is certainly recognizable as a juvenal.

In comparing dimensions of the several subspecies, the normal size difference between the sexes must be kept in mind.

***Conopoderas caffa postrema*, new subspecies**

SUBSPECIFIC CHARACTERS. Resembling *Conopoderas caffa aquilonis*, of Eiao Island, but averaging slightly smaller, except in the size of the bill, and with a less yellowish and more olivaceous dorsal surface.

TYPE.—No. 195,395, Amer. Mus. Nat. Hist.; ♂ ad.; Hatutu Island, Marquesas Group; September 27, 1922; R. H. Beck.

MEASUREMENTS.—(5 males [10 for length of wing, tail, and bill from nostril]): wing, 86-95.5 (91.7); tail, 72-81.1 (77.4); exposed culmen, 18.7-20 (19.8); bill from nostril, 14.6-16 (15.4); tarsus, 29-30.7 (29.6) mm.

5 females: wing, 87-92 (89); tail, 71-78 (74.6); exposed culmen, 19-20 (19.5); bill from nostril, 15.3-16 (15.6); tarsus, 28.5-30.7 (29.3) mm.

RANGE.—Hatutu Island, Marquesas.

Specimens from Hatutu collected during September and October, 1922.

Eiao and Hatutu Islands lie a little more than three miles apart, some sixty miles from Nukuhiva, which is the next nearest land mass in the archipelago. This remote pair of small islands might be expected to harbor closely related warblers. The relative difference between the subspecies *postrema* and *aquilonis* may be expressed roughly by saying that the former has a "grayish-green" back, the latter a "yellowish-green" back. When fifteen skins from each island were selected at random, and laid on their bellies with the labels concealed, an observer who had no knowledge of the circumstances was able to divide the specimens correctly. With only two or three specimens available, the distinctions would be harder to appreciate.

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LUMBRINEREIS BICIRRATA, A NEW POLYCHÆTOUS ANNELID FROM PUGET SOUND

A. L. TREADWELL

Following is the description of a new species of *Lumbrineris* collected in Puget Sound, State of Washington, by Dr. V. E. Shelford, and submitted to me for study.

Lumbrineris bicirrata, new species

The size of the specimens varies considerably, but one of medium size and incomplete posteriorly, measured 195 mm. in length with a prostomial width of 3 mm. and a width at the 20th somite of 7 mm. This latter width was continued through the greater part of the body, but toward the posterior end there was a definite narrowing. None of the specimens was complete and no information is available concerning the structure of the pygidial region.

The prostomium (Fig. 1) is roughly triangular in outline with the anterior angle rounded. Its greatest length is a trifle more than the length of the three first somites. The peristomium is dorsally not more than one-quarter as long as the prostomium and is slightly shorter than somite 2. On the ventral surface somites 1 and 2 coalesce to form a swollen posterior lip to the mouth. Laterally, each end of this lip is continued into a smaller fleshy ridge which bends toward the median line and doubles back on itself, to merge laterally with the postero-lateral angles of the prostomium. These two ridges are in contact on the median line. Somites behind the second gradually increase in width up to the 20th, where the greatest body width occurs.

The first parapodium is on somite 3. This and later ones are similar in form but there is a regular increase in size relatively to the increase in body diameter. In each parapodium there is a fleshy anterior lip and a longer, thinner, posterior one. In the region of somite 25 (Fig. 2) the basal portion of the parapodium becomes longer, and the two terminal lips are of about equal length, the apex of the posterior one being the less pointed of the two. On the posterior lip is a cirrus-like outgrowth, extending dorso-laterally. Behind the general region of the 100th somite, each lip develops a cirrus-like process, that of the posterior lip extending dorsally, that of the anterior lip more nearly laterally. These processes progressively increase posteriorly until in the posterior somites they are equal in length to one-half the body diameter (Fig. 3). A somewhat similar condition was described by Moore in *Lumbrineris erecta* (1904, Proc. Acad. Nat. Sci., Phil., p. 490), but while in that species the posterior lip bears such a process, it is not present on the anterior one. *L. erecta* differs, also, from *bicirrata* in the form of the jaw.

The 25th parapodium has 4 or 5 aciculæ. In later ones the number is reduced to 3, one of which (Fig. 3) bends toward the dorsal surface and is smaller than the others.

The anterior setæ are prominent, probably from 20 to 25 in a bundle, but so many are broken that it is difficult to get the correct number. The shafts are very slender (Fig. 4) but vary in length. The apical portion is about as long as the shaft and is slightly bent. There is a wing along the convex margin. In posterior somites this type of seta disappears and its place is taken by another (Fig. 5). These are very much stouter

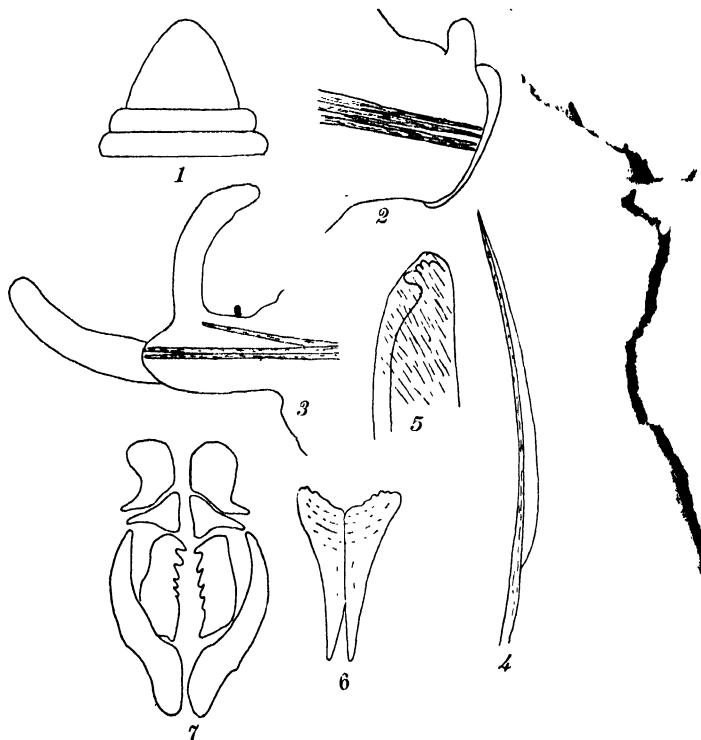


Fig. 1. Prostomium, $\times 27.5$.

Fig. 2. Twenty-fifth parapodium, $\times 27.5$.

Fig. 3. Posterior parapodium, $\times 27.5$.

Fig. 4. Anterior seta, $\times 67.5$.

Fig. 5. Posterior seta, $\times 250$.

Fig. 6. Mandible, $\times 9$.

Fig. 7. Maxilla, $\times 9$.

than those in anterior somites. They narrow abruptly toward the end and the apex carries several teeth, of which the ventralmost is the largest. The terminal portion is covered by a hood of the usual type, i.e., a flat plate on either side extending beyond the apex of the seta. In full-face, the end of the seta shows between the two plates. In profile, the end seems to be covered by a transparent hood. So many setæ were

broken that I was unable to determine the precise part of the body where the change from one of these types to the other occurs.

The mandibles (Fig. 6) are light brown in color, with very dark antero-lateral angles and concentric lines near the cutting edge. They are rather short and broad. The maxillæ (Fig. 7) are very black in color. The carriers and forceps are strong. The right paired plate has 4 obvious teeth with a small 5th which is hardly a true tooth, while the left one has 5. Terminally there is on either side a pair of plates of which the proximal one is slightly the smaller.

The type was collected at Diamond Point, Friday Harbor, and is in The American Museum of Natural History (Cat. No. A. M. N. H. 1692).

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NEW DIPTERA IN THE AMERICAN MUSEUM OF NATURAL HISTORY

By C. H. CURRAN

During the identification of several small collections of Diptera many undescribed forms have come to light. For the most part these have been placed aside until such time as the groups to which they belong may receive more detailed consideration, but descriptions of a few of them have been prepared and are presented at this time. The types of the new species are in The American Museum of Natural History.

Chironomidæ

Crictopus abana, new species

Closely allied to *C. flavibasis* Malloch but readily distinguished by the wholly brown or blackish tarsi in the female and wholly black abdomen in the male; from *brunnicans* Walley, to which it traces in Walley's key (Can. Ent., LX, p. 21, 1928), it is readily distinguished by the yellow pleura and abdominal venter. Length, 2 mm.

MALE.—Head brown; large, basal antennal segment shining black. Thorax shining black, very lightly gray-dusted, the humeri, sides of mesonotum in front of the wings and upper third of the pleura, yellowish; mesopleura brown. Anterior coxæ and all the trochanters, yellowish; tibiæ white with less than the basal fifth and apical sixth black; front tarsi wholly and apical segment of the other tarsi, black, the tips of the tarsal segments brownish, the posterior four tarsi otherwise white; femora shining black. Pale parts of legs white-haired. Wings rather whitish. Halteres pale yellow. Abdomen dull black, the first segment wholly, tips of the second to fifth segments and their lateral margins, shining black. Genitalia white.

FEMALE.—Very different in coloration. Face, area about base of antennæ and the basal two or three antennal segments, yellowish; mesonotum with a pair of wide yellow vittæ; pleura yellow, the pectus and a spot on the mesopleura brown; scutellum more or less yellowish brown; posterior four femora reddish on basal two-fifths; tarsi brown, somewhat paler basally; first abdominal segment reddish yellow, the segmental apices not conspicuously shining; venter pale yellow, the apical sternite black; valves of ovipositor white.

HOLOTYPE.—Male, Birtle, Manitoba, Canada, May 26, 1928. ALLOTYPE.—Female, Birtle, May 21. PARATYPES.—Two males and two females, Birtle, May 21, 1928. All collected by R. D. Bird.

Paratypes are deposited in the Canadian National Collection, Ottawa, Canada.

There is another female taken at the same place on May 24 which has a length of 3 mm., the antennæ wholly brown and each abdominal segment with a subquadrate yellowish spot on either side. It agrees in many respects with *flavibasis* Malloch, but evidently represents an undescribed species.

Stratiomyidæ

Chrysochlora Latreille

The following table separates the described species belonging to this genus.

1. Front with black vitta or largely black: 2.
Front yellow, at most the ocellar triangle brown. 10.
2. Face yellowish, at least below. 3.
Face blue or green (Mexico). 9.
3. Front purplish. *annulipes* Walker.
Front partly yellowish. 4.
4. Scutellum yellowish, the base black; mesonotum always vittate. 5.
Scutellum black, the apex broadly yellowish or the thorax not vittate. 8.
5. Second abdominal segment without a median pale vitta. 6.
Second segment with median pale vitta. *pluricolor* Bigot.
6. Wings with dark cloud at middle and near apex. *willistoni*, n. sp.
Wings evenly clouded on apical half, at least in front. 7.
7. Costal border evenly brown; segments without median black spots (Guiana).
castanea Macquart.
Costal border not noticeably darker than apical half of wing; segments each with
a median black spot. *femoralis*, n. sp.
8. Thorax vittate (Cuba). *quadrilineata* Bigot.
Thorax not vittate (Galapagos). *fasciata* Thomson.
9. Front with two yellowish spots anteriorly (Venezuela). *maculiventris* Rondani.
Front wholly metallic. *purpurea* Walker.
10. Pleura and pectus wholly yellow. *incompleta*, n. sp.
Pleura and pectus in part brownish or black. 11.
11. Pectus in part black. 12.
Pectus wholly pale, scarcely darker than pleura. *varia*, n. sp.
12. Costal border of wings broadly and evenly brown. *similis* Macquart.
Costal border luteous or not evenly brown. 13.
13. Wings with median and apical brown spot on anterior half. *vespertilio* Fabricius.
Wings evenly luteous in front. *pulchra* Williston.

Chrysochlora willistoni, new species

Similar in appearance to *vespertilio* Fabricius, but the median third of the front shining black. Length, 12 mm.

FEMALE.—Head yellow, the lateral two-fifths of the occiput and the median third of the front, except above and below, black; occiput grayish pollinose, hair short, pale yellowish; face receding on lower third, prominent in middle; median third of front raised, convex, depressed across lower fifth. Antennæ reddish, the third segment with six conspicuous annules, the style black. Proboscis brownish.

Thorax subshining black; mesonotum with a pair of rather narrow, broadly separated, yellow vittæ and the side margins, interrupted immediately behind the humeri and more broadly behind the suture, reddish yellow. Scutellum reddish yellow, its base black. Prothorax entirely, a large spot on the meso-, sterno- and pteropleura and another on the hypopleura, reddish yellow. Pile very short, yellow, partly black on the dorsal black vittæ.

Legs yellowish, the femora and coxæ more reddish.

Wings luteous, with a roundish preapical spot and another at the middle of the wing in front, brown, the apical and posterior fourth grayish brown, more evident along the veins.

Abdomen banded black and yellow, the black bands basal, that on the second segment narrower than the yellow, on the fourth wider, the black bands triangularly produced in the middle to the posterior border of the segments; first segment with a transverse blackish spot, fourth black with a large, semicircular median apical spot which reaches to the basal fourth of the segment.

HOLOTYPE.—Female, Chapada, Brazil. PARATYPES.—Two females, Chapada. Williston Collection.

This species was recognized by Dr. Williston as distinct from any of those already described.

Chrysochlora incompleta, new species

Yellow, with black and ferruginous markings on thorax and abdomen. Length, 15 mm.

FEMALE.—Head yellowish, the lateral two-fifths of the occiput and the ocellar triangle black; pile short, yellowish, black on the upper three-fourths of the front, front slightly concave on lower half, gently convex above; face most prominent below. Antennæ reddish, the apical three annuli of the third segment and the arista, brown. Proboscis reddish yellow.

Mesonotum with a rather narrow, anteriorly tapering entire median black vitta, and on either side behind the suture a broad, posteriorly tapering black stripe, in front of the suture with an obscure brownish stripe on either side, basal third of scutellum shining black; pile short, yellow, black on the black stripes behind the suture.

Legs yellow; middle and hind coxæ exteriorly and the apical third of the posterior femora brown.

Wings cinereous hyaline, with a conspicuous brownish spot at the stigma, the costa luteous, the apical fourth and broad posterior border grayish.

Abdomen ferruginous, the first segment with a large, quadrate yellow spot on either side, the second to fourth with increasingly broad, transverse triangular spots on apex of either side, the spots narrowly separated from each other, becoming more convex anteriorly on the apical segments. Fifth segment yellow with a basal ferruginous spot in the middle. Pile black, yellow on the yellow triangles. Venter wholly yellow.

HOLOTYPE.—Female, Rio de Janeiro, Brazil. Williston Collection.

Chrysochlora varia, new species

Head yellowish, abdomen varying from ferruginous to black, with yellow bands; wings with darker preapical and stigmal spots; pectus wholly pale. Length, 12 to 13 mm.

MALE.—Head yellowish, the ocellar triangle and lateral two-fifths of the occiput shining blackish; front rather narrow, widening slightly below, the lower three-fifths flat or very slightly concave, the upper part convex, with a low swelling on either side, black-haired, the head elsewhere with short yellowish pile; face receding on lower fifth, straight above. Antennæ reddish, the tip of the third segment and the arista brown. Proboscis yellow.

Thorax rusty yellowish, the mesonotum with three moderately narrow black vittæ, the outer two abbreviated in front and behind and narrowly interrupted at the suture; notopleura and a short, narrow stripe on the mesopleura, shining brown. Scutellum yellow, the base black.

Legs yellowish, the posterior four femora somewhat darker on apical third.

Wings luteous on anterior half, with a brownish subapical cloud and a slight brownening about the stigma, elsewhere grayish brown.

Abdomen ferruginous or black, each segment broadly yellowish or reddish apically, the pile black, yellow on the pale parts of the basal four segments.

FEMALE.—The abdomen is black, the first segment, base of second except the sides, most of the second segment, leaving a narrow, transverse fascia which is very strongly, triangularly widened laterally and the apex of the third, rusty reddish.

HOLOTYPE.—Male, Bartica District, British Guiana. **ALLOTYPE.**—Female, British Guiana, February 12, 1913, (H. S. Parish). **PARATYPE.**—Male, Bartica District.

The difference in coloration of the two sexes may be only a variation which may occur in either sex.

***Chrysoclora femoralis*, new species**

Blackish, ferruginous and yellow; abdomen with a median series of small, black spots. Length, 16 mm.

MALE.—Head yellowish, front brownish red, with a brown median vitta extending more than halfway to the antennæ; ocellar tubercle and lateral two-fifths of the occiput black. Face and front black-haired. Front almost evenly convex, moderately wide; face prominent, gently convex, strongly so on lower edge. Proboscis ferruginous. Antennæ reddish, the arista brown.

Prothorax yellow; mesonotum olive-brown, with a median black spot posteriorly and a broad shining black vitta on either side, the humeri, notopleura and posterior calli yellow; pile yellow, black on the black parts behind the suture and on the black basal third of the scutellum. Pleura mostly yellowish, a black spot in front, another on the anterior border of the pteropleura, the metanotum and pectus also black.

Legs, including the coxæ, yellow; basal half of the posterior four femora black or brown.

Wings brownish, with a hyaline vitta on the basal half extending from the alulet to just behind the discal cell, in front of a deeper, yellowish-brown color.

Abdomen ferruginous, the apices of the segments broadly yellowish or reddish, the yellow fasciæ narrowed in the middle and at the sides; in the middle with a deep black vitta composed of a black spot on each segment, the sides of each segment with a subtriangular black spot; first segment with an entire black fascia. Apical three sternites each with a broad, transverse black spot.

HOLOTYPE.—Male, Rio Frio, Magdalena, Columbia, July 18, 1927, (G. Salt).

***Cyphomyia abana*, new species**

Related to *auriflamma* Wiedemann but readily distinguished by the pale pilose face, much wider vertex and the fact that the front is very convex immediately in front of the ocelli instead of being depressed. Length, 13 mm.

FEMALE.—Head yellow, yellow-haired; proboscis, palpi and antennæ black. Front wide, broadening posteriorly, practically bare, in profile strongly convex above; a conspicuous depression on either side of the ocelli, much higher than the posterior orbits at the vertex which is broad and rounded. Antennæ black-haired, third segment longer than head, with almost parallel sides, pointed apically. Ocellar triangle brownish.

Thorax steel-blue, black-haired dorsally and on the hypopleura and upper border of the pteropleura; with sparse long hair on the dorsum. Pleura with whitish-yellow hair.

Legs black, black-haired; basal segment of the tarsi yellowish with black apex, the hair largely yellow.

Wings blackish brown. Squamæ black; halteres yellow.

Abdomen steel-blue, black-haired.

TYPES.—Holotype, female, and paratype, female, Amazon, Brazil.

***Cyphomyia regularis*, new species**

Related to *auriflamma* Wiedemann, but at once distinguished by the wholly yellow face and the absence of a deep groove separating the vertex and posterior orbits. Length, 13 mm.

FEMALE.—Head pale yellowish, the ocellar spot brown, palpi, proboscis and antennæ black. Front rather evenly convex, the median depression shallow, a longitudinal depression on either side of the ocelli, the vertex at point of junction with the posterior orbits conspicuously depressed; pile fine, short, blackish behind the ocelli, elsewhere on head yellowish. Antennæ black-haired, third segment missing.

Thorax black, black-haired dorsally, a few pale hairs in the middle in front; pleura whitish haired. Humeri reddish; pleura with reddish tinge posteriorly. Hypopleura and the pteropleura black-haired above.

Legs brown, black-haired; basal segment of all the tarsi and the base of the following segment reddish yellow and mostly yellow-haired.

Wings blackish brown; squamæ brown; knob of halteres yellow.

Abdomen metallic blue with purplish reflections, black-haired.

HOLOTYPE.—Female, Rio de Janeiro, November, (Williston Collection).

***Cyphomyia sulcifrons*, new species**

Related to *auriflamma* Wiedemann from which it is distinguished by the presence of a deep longitudinal groove extending from the ocelli almost to the antennæ. Length, 11 mm.

FEMALE.—Head whitish yellow, the posterior orbits wide, angulate behind; front at vertex much higher than the orbits, strongly convex between the groove and eye; face reddish brown; the sides with white hair, the middle and posterior orbits below, black-haired; front wholly bare; ocellar triangle black. Antennæ black, the basal segments black-haired; third segment tapering from near base, as long as the head. Proboscis and palpi black.

Thorax blue-black, mesonotum and scutellum short black-haired, an obscure, narrow median vitta on the anterior half of the mesonotum, a short vitta projecting forward from the base of the scutellum on either side, and the pleura, pale yellow-haired. Humeri and apical fourth of scutellar spines reddish yellow. Pteropleura above, and the hypopleura, black-haired.

Legs brown; basal segment of all the tarsi wholly and the basal half or more of the second segment, whitish. Legs black-haired, the pale parts of the posterior four tarsi with whitish hair.

Wings blackish brown; squamæ and knob of halteres brown.

Abdomen metallic blue, wholly black-haired.

HOLOTYPE.—Female, La Buena, Ventura, Vera Cruz, Mexico.

This species differs from *auriflamma* female, not only in the shape of the front but in having the frontal hair so short as to be inconspicuous, it being short but very conspicuous in *auriflamma*, which also has wholly yellow hair on the occiput below the eyes.

Bombyliidæ

Heterostylum xanthobasis, new species

Wings cinereous hyaline, the base broadly yellowish, bordered with pale brownish. Length, 8 to 12 mm.

MALE.—Head blackish in ground color, cinereous pollinose, the front and face cinereous yellow pollinose; face and cheeks yellow in ground color. Pile yellow, becoming white on the lower half of the occiput and on the cheeks; a few blackish hairs on the ocellar triangle. Proboscis shining black, almost half as long as the body. Antennæ black, the basal two segments grayish ochreous pollinose, the first with yellow, the second with black hairs; style not twice as long as wide, obtusely pointed.

Thorax black, the sides of the mesonotum and the pleura with grayish pollen, the pleura sometimes largely reddish in ground color. Pile yellowish, white on the pleura and pectus. Scutellum reddish.

Legs reddish, the apices of the femora narrowly, the apical four segments of the anterior four tarsi and the posterior tibiæ and tarsi wholly, brown.

Abdomen reddish, with a median black spot on the base of the second and third segments and broad blackish fasciæ on the remaining segments; pile yellowish, a few black hairs towards the sides of the apical segment.

FEMALE.—Front blackish in ground color, except anteriorly with scattered black hairs.

HOLOTYPE.—Male, Sevillano, June 20, 1927. ALLOTYPE.—Female, Sevillano, May 26, 1927, (N. 342). PARATYPES.—Male, female, Sevillano, Sept. 20, 1927 and Nov. 14, 1927; two males, Clenaga, Nov. 14, 1926. All collected by G. Salt. Both localities are in Magdalena Province, Colombia.

In one specimen the spots are greatly widened on the basal segments so as to form incomplete fasciæ.

Empididæ***Drapetis deceptor*, new species**

Shining black, the halteres yellow; similar to *pilosa* Melander but at once distinguished by its yellow halteres. Length, 1.75 mm.

MALE.—Face linear; palpi with brownish yellow hair; posterior orbits gray pollinose. Antennæ black, the second segment with weak bristle below; third segment one and one-half longer than wide, tapering, the arista apical. Thorax with long, black bristly hair in addition to the extremely short subappressed hair; pteropleura gray pollinose. Legs black; without conspicuous bristles, each femur with a weak preapical anteroventral bristle; tarsi reddish brown. Wings slightly cinereous, the veins brownish luteous; anterior crossvein beyond middle of discal cell; squamal fringe white. Abdomen with short, appressed yellowish hair. Genitalia small, not cleft, suboval from lateral view, the valves not fringed, the right valve bare, the left haired.

HOLOTYPE.—Male, Birtle, Manitoba, Canada, May 22, 1928, (R. D. Bird).

***Rhamphomyia birdi*, new species**

Entirely black, the wings gray; posterior tibiæ and tarsi swollen; legs with abundant hair. Length, 3 mm.

MALE.—Face and occiput with grayish pollen; eyes contiguous for a long distance; proboscis a little more than half as long as head-height; antennæ black, the third segment three times as long as wide, strongly narrowed on basal fourth, thence gradually tapering, the style about as long as the basal width of the third segment. Hair black.

Thorax moderately gray pollinose, the hair long, black, the scutellum with six or eight marginal hairs. Hypopleural hair black.

Legs black, the posterior tibia swollen on apical fourth, the first segment of the posterior tarsi much swollen, thicker than the tibia, largest in the middle. Femora with normal hair, that on the posterior pair longer; tibiæ and tarsi with abundant, long hair dorsally.

Wings grayish; anterior section of discal crossvein short, the venation normal. Squamæ and fringe brown. Halteres with brownish-red stems.

Abdomen thinly brownish gray pollinose, tapering from the base, black-haired. Genitalia small, the filament slender, straight, mostly hidden.

FEMALE.—Front gray pollinose; legs simple and with short hair; abdomen tapering.

TYPES.—Holotype, male, and allotype, female, Birtle, Manitoba, Canada, May 26, 1928. Paratype, male, Birtle, May 21, 1928. All collected by R. D. Bird. Paratype in Canadian National Collection.

The paratype has most of the posterior part of the discal crossvein evanescent.

***Rhamphomyia luteiventer*, new species**

Black, the legs, halteres and venter yellow; pile on sides of abdomen yellow. Length, 4 mm.

MALE.—Face and occiput thickly gray pollinose; eyes contiguous for considerable distance on the front; hair black. Proboscis as long as head-height. Antennæ long,

the third segment tapering from near the base, a little more strongly so on the basal fourth, the style half as long as basal width of third segment.

Thorax gray pollinose, with brownish tinge dorsally; hair in definite rows, moderately long; scutellum with four marginal bristles; hypopleural hair bristle-like.

Legs reddish yellow, rather slender, the tarsi brown from the apex of the first segment, the second segment of the posterior pair mostly obscure reddish. Hair wholly black, the front coxæ with a single row of hairs in front on outer side.

Wings cinereous hyaline, the venation normal. Squamæ yellowish, with yellowish fringe; knob of halteres pale yellow.

Abdomen brownish pollinose, the sides more grayish; dorsally with short black hair, on the sides with longer, fine, yellow hair. Venter pale yellow, the apical one or two sternites brown, the hair yellow. Genitalia of moderate size, the filament reddish, large on basal half, the apical half slender.

HOLOTYPE.—Male, Birtle, Manitoba, Canada, June 22, 1928, (R. D. Bird).

Phoridae

Aphiochæta catana, new species

Belongs to the group in which the proboscis is chitinized and projecting; differs from related species in possessing long and strong preapical bristles on middle and posterior tibiae. Length, 1.35 mm.

FEMALE.—Black, moderately shining. Two pairs of supra-antennal bristles; four pairs of orbitals, the lower pair well in from the orbit and convergent, the upper pair obliquely divergent; preocellars and ocellars strong, the verticals much weaker. Palpi large, yellow, with black bristles; proboscis brown, tapering, chitinized. Antennæ black.

Mesonotum with three pairs of bristles in addition to the two pairs on the notopleura, the hair appressed, very short; scutellum with two bristles; pleura thinly grayish pollinose posteriorly.

Legs reddish; middle coxæ, upper surface, base and apex of posterior femora, their tibiae except on lower basal half and the tarsi wholly reddish brown to blackish; middle tibiae with two anterodorsal setæ on basal third; posterior tibiae with a row of about ten posterodorsal setæ.

Wings grayish; third costal section hardly half as long as second; costal fringe moderately short. Halteres pale yellow.

Abdomen when viewed from behind with the disc brownish-gray pollinose; sides and apex with obscure brownish hair.

HOLOTYPE.—Female, Birtle, Manitoba, Canada, March 23, 1928, (R. D. Bird).

Most nearly related to *proboscidea* Melander and Brues, but that species has a short preapical bristle on the posterior tibiae

Sepsidae

Paratoxopoda varicoxa, new species

Related to *villicoxa* Duda but differs from it in lacking erect or suberect hair on the front coxæ. Length, 7 mm.

FEMALE.—Face, cheeks and antennæ orange-red, proboscis and front brown, the latter with steel-blue reflections; occiput black with slight greenish tinge. Arista brown.

Thorax greenish black, faintly grayish pruinose, the scutellum brown pollinose; humeri brown. Obscure hair on pleura yellowish.

Legs brown; posterior four coxæ and broad base of posterior femora, reddish. Hair black; more abundant on the apices of the front coxæ than in most species, but not erect nor as abundant as in *villicoxa* Duda.

Wings cinereous hyaline, the costal cell blackish. Squamal border and fringe brown; halteres brownish red.

Abdomen black, the basal two segments reddish. Apical segments with greenish reflection, the fifth and following segments polished.

HOLOTYPE.—Female, Memeh Town, Liberia, August 29, 1926, (J. Bequaert).

This species and *villicoxa* Duda are separable from all the described species in the genus by the absence of the apical bristle on the anterior coxæ. The female of *villicoxa* possesses abundant, short, fine, erect and suberect hairs on the apical third of the anterior coxæ but in *varicoxa*, while the hairs are more numerous than in other species, they are less abundant than in *villicoxa* and none of them are erect.

PLATYTOXOPODA, new genus

Differs from the genera in the family in having the oral margin produced so that the head is longest below, the oral opening very large. Lower edge of head horizontal, straight, the vibrissal angles less prominent than the oral margin, bearing two or three vibrissæ: facial carina very broad, gently convex, not conspicuous; parafacials and cheeks linear. Front with pair of moderately strong orbitals, the ocellars as long as orbitals, postocellars of equal length with the single pair of verticals, long and strong. Antennæ almost as long as the face, the third segment tapering to a rounded point, slightly over twice as long as wide. Thorax not punctured or shagreened, thinly pollinose, the pleura with fine yellowish pile; propleural bristle absent; humeral strong; two notopleurals, two supra-alars and two pairs of dorsocentrals; one pair of scutellars. Anterior tarsi broadened, narrowing from the tip of the first segment to the base; middle femora broadly hollowed above just beyond the middle, thickened before the middle; posterior femora and tibiæ each with a row of six bristles above. Wings as in *Toxypoda* Macquart. Abdomen slightly constricted at base of second segment.

GENOTYPE.—*Platytoxopoda bequaerti*, new species.

In many respects this genus shows affinities to certain of the Ortaliidæ, but it is without question a sepsid. The Sepsidæ may be separated from allied families by the presence of a long bristle arising from the lower corner of the posterior spiracle of the thorax, a character found also in the family Rhopalomeridæ, but in that family the occiput is concave or flattened while in the Sepsidæ the posterior orbits are always convex. We find therefore that the Sepsidæ have the head more or less rounded and almost as long as high while in the Rhopalomeridæ the head is almost twice as high as long and the vertex is excavated. Moreover, there are many other differences. In a few of the smaller sepsids the bristle is yel-

lowish and less easily seen but it is always present; the use of this character eliminates the Piophilidæ from the family Sepsidæ and furnishes a ready means of recognition for members of the family.

Platytoxopoda bequaerti, new species

Black, the face and anterior half of the cheeks brownish red. Length, 6 to 6.5 mm.

FEMALE.—Ocellar triangle large, reaching to the base of the antennæ, shining, with a narrow, median longitudinal groove; orbits shining, the orbital bristle situated in a shallow depression; the front elsewhere dull black; occiput thinly gray pollinose.

Thorax rather thinly gray pollinose, the disc of the mesonotum and the scutellum brown. Propleural hairs yellow.

Legs blackish; hair black; front coxæ with two short, apical bristles in front, otherwise almost bare; middle and hind coxæ rather silvery; middle tibiæ swollen on apical third and with a row of three to five ventral bristles.

Wings cinereous hyaline, the veins brownish yellow; basal fourth of costal cell and the humeral cell, brown. Squamæ brown, with brownish yellow fringe; halteres blackish.

Abdomen with thin grayish pollen, the hair black, inconspicuous on the disc. Ovipositor projecting, bright reddish.

HOLOTYPE.—Female, Mbaga, Belgian Congo. PARATYPES.—Two females, Kasonsero, Congo. All collected by Dr. J. Bequaert.

Themira maculitarsis, new species

Very similar to *malformans* Melander and Spuler but the middle tarsi are white and black, the front legs are differently shaped, etc. Black; halteres and squamæ yellow, the squamal fringe white. Length, 3.25 mm.

MALE.—Almost wholly shining black. Cheeks brownish red on upper half. Pleura behind thinly gray pollinose; hair of thorax black. Anterior femora strongly concave on basal half anterodorsally and on subapical two-fifths posteroventrally; before the apical concavity with an apically forked process which is flat and about one and one-half times as long as wide, situated on the anteroventral surface, on the posteroventral edge with a smaller, triangular, slightly curved, process; at the base of the anteroventral surface, a moderately long bristle, ventrally on the basal half a row of fine bristly hairs, dorsally on the apical half a row of five or six bristly hairs. Anterior tibiæ greatly deformed, increasing in width to a little beyond the middle, where they are strongly and abruptly narrowed on the anterior edge, beyond which point they are gently concave to the apex, at the corner preceding the constriction with a long, black spine which extends almost to the apex of the tibia. First segment of the anterior tarsus slightly longer than the following segment, armed at the apex with a long black bristle and one or two short ones, the second segment inserted at the middle of the under surface of the first segment, which is pubescent before the point of insertion, bare beyond. Middle femora gently curved, convex in front, on the apical third of the posterior surface with an oblique row of fine, apically curved ciliate hairs; middle tibiæ with very short, erect, fine hair dorsally; basal two-thirds of first, half of second, third of third and fourth of fourth tarsal segments whitish, the middle tarsi otherwise black. Posterior legs simple.

Wings cinereous hyaline. Squamal fringe white.

Abdomen widening apically from base of third segment, the sides of the fifth tergite produced downwards to form a long, strap-like, more or less deformed lobe either side which bears an apical fringe of very long, coarse black hairs which are more or less matted together and most of which are as long as the abdomen. The posterior forceps are thick and of uneven form.

HOLOTYPE.—Male, Birtle, Manitoba, Canada, July 7, 1928, (R. D. Bird).

Differences in the shape of the front and middle legs, the genitalia, and the color of the middle tarsi separate the species from *malformans* which has wholly yellow middle tarsi.

Ortaliidæ

Rivellia abana, new species

Figure 1

Wings markings very similar to *viridis* var., Hendel ('Gen. Ins.,' Fasc., 157, Fig. 15) but the first basal cell is mostly brown on the basal half and there is a small brown triangle in the apex of the marginal cell. Length, 3.5 to 4 mm.

Face, front, cheeks and palpi reddish, the front opaque; ocellar triangle and a shining spot on either side above, ferruginous, the orbits and face white pollinose, the broad oral margin and cheeks shining. Hair of front and upper half of the occiput black, on lower half of occiput and cheeks, yellow. Proboscis black, clypeus brown. Antennæ reddish yellow, the third segment brown apically; arista black.



Fig. 1. *Rivellia abana*, new species. Wing.

Thorax æneous; propleura white pollinose; mesonotum, a triangle on the mesopleura and the metanotum, moderately white pollinose. Hair black dorsally, whitish on the pleura. Broad apical margin of scutellum shining black, the dorsal surface pollinose.

Legs black; coxæ reddish or reddish brown; trochanters, knees broadly, and all the tarsi, reddish.

Abdomen bronze-black, the first segment and the apical two greenish. Hair black.

TYPES.—Holotype, female, allotype, male, Plum Farm, June 6. Paratypes: one male, eleven females, Baky Island, June 5; two females, Plum Farm, June 6, 7. All collected by T. D. A. Cockerell. The localities are in New Caledonia.

Trypaneidæ

Ensina conflictæ, new species

Figure 2

Related to *E. longirostris* Thomson but with two hyaline spots in the marginal cell, one beyond the apex of the cell and one at the tip of the wing; differs from *cratericolla* Grimshaw in the anterior crossvein being situated behind the hyaline spot and more extensively brown wings. Length, 3 mm.

MALE AND FEMALE.—Head reddish yellow, whitish pollinose; occiput black in ground color; front not pollinose except laterally; oral margin shining; three pairs of black and one of white frontals; ocellars, verticals and two or three occipital cilia black, the postocellars and two pairs of occipital cilia white; projection above neck with three pairs of short, white bristles. Proboscis more than twice as long as head-height, palpi sometimes with brown apices. Antennæ reddish, the third segment a little darkened apically; arista brown, pubescent.



Fig. 2. *Ensina conflictata*, new species. Wing.

Thorax thickly gray pollinose, yellow-haired, the dorsal pteropleural bristles black; two scutellars.

Legs reddish; femora, except their broad apices, black; posterior four coxæ and apical one or two tarsal segments reddish brown.

Wings hyaline, with brown markings generally as in figure 2. There is considerable variation in the extent of the brown markings although those on the border of the wing are constant: in the brown field there may be indications of two or three additional hyaline spots.

Abdomen gray pollinose, with a double row of large, subshining brown spots dorsally, the spots more or less fused on basal segment. Hair sparse, pale, the third and fourth segments each with one or two black bristles on either side apically. Ovipositor polished black, with reddish apical segments.

TYPES.—Holotype, male, allotype, female, six males and four female paratypes, Baky Island, June 5, and one male, Dge, June 6, (T. D. A. Cockerell). Both localities are in New Caledonia.

Tachinidæ

Erycia deckeri, new species

Related to *myoidea* Desvoidy but there are only three sternopleurals and the ultimate section of the fourth vein is not bowed inwards, but straight; in my key (Can. Ent., LIX, p. 15) traces to complete 14, where it differs from both species by having the knob of the halteres black. Length, 7.5 mm.

FEMALE.—Black, with whitish pollen. Head grayish-white pollinose, the frontal orbits almost bare above, at their middle a little more than half as wide as the reddish-brown frontal vitta; seven or eight pairs of frontals, the two upper pairs reclinate, the lower three below the base of the antennæ, strongly diverging below; front one-fifth wider than greatest width of eye. Face strongly and evenly retreating in profile; vibrissæ almost level with oral margin, three or four bristly hairs above them; cheeks one-sixth as wide as eye-height. Palpi brown. Antennæ black, reaching almost to the vibrissæ, the third segment with almost parallel sides, hardly three times as long as wide, its apex angular above, rounded below; arista thickened to beyond the middle, its basal segment not twice as long as wide.

Thorax and scutellum rather thickly pollinose, the four vittæ distinct; bristles typical of the genus; four pairs of scutellars, the apical cruciate pair suberect. Three pairs of sternopleurals.

Legs black; middle tibiæ with one strong and one weak anterodorsal bristle; posterior tibiæ with seven anterodorsal bristles.

Wings cinereous hyaline; apical crossvein straight or almost so; a single basal bristle on base of third vein above and below. Squamæ pale yellowish; halteres with brown knob. From dorsal view the basal third of the abdominal segments appears thickly whitish pollinose, the pollinose bands broadly interrupted in the middle; from anterior view the pollen extends thinly to the apical fourth of the segments except towards the sides, which remain black from all views. Second segment with pair of discals and marginals and a long lateral marginal; third with pair of discals and row of marginals, fourth with discal and submarginal row, the marginal row weak.

HOLOTYPE.—Female, Ames, Iowa, August 18, 1928, (Geo. C. Decker), parasite of *Papaipema nebris* Guenée.

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NINETEEN NEW DIPTERA FROM AFRICA

BY C. H. CURRAN

In the following pages descriptions of apparently undescribed African Diptera are given, together with the description of a new genus of Tachinidæ. Most of the flies discussed herein were collected by Dr. Joseph Bequaert during an extended trip to the Belgian Congo and Liberia and it is intended at a later date to prepare a detailed report of the Diptera collected by him. Unless otherwise stated, the types of the new species are in The American Museum of Natural History.

Pipunculidæ***Pipunculus bequaerti*, new species**

Black, the abdomen opaque with the third and following segments broadly shining black apically; legs yellow; stigma complete; wings light brown. Length, 6 mm.

MALE.—Eyes touching for a distance greater than the length of the frontal triangle which is silvery, with a rectangular black spot below when viewed from above; vertical triangle shining black; face narrow, silvery white; labellæ and palpi reddish. Occiput gray pollinose, brown above. Antennæ reddish yellow, the third segment not acuminate; arista black, the basal thickening of moderate length.

Thorax black, brown pollinose, the notopleura gray at sides; humeri yellow, mesopleura blackish in front; a row of short, fine dorsocentral hairs and some hair in front of the notopleura. Scutellum brown with row of longish marginal hairs.

Legs, yellow, the coxæ brown, gray pollinose; apical three tarsal segments brownish, the apex of the fifth segment reddish. Pulvilli of medium size. Posterior tibiæ strongly swollen at the middle, with three bristles on the swelling in front. Hair of legs black.

Wings strongly tinged with brown; stigma brown; anterior crossvein at basal third of discal cell. Squamæ whitish. Halteres yellow, the knob reddish brown apically.

Basal abdominal segment gray pollinose except the narrow base; abdomen opaque black, the apex of the second segment cinnamon-brown, of the following segments very broadly shining black, with a gray pollinose spot on the sides. Genitalia brown pollinose, the forceps very long and curved upwards at almost right angles near their middle.

HOLOTYPE.—Male, Lubutu, Congo, (J. Bequaert).

***Pipunculus lubuti*, new species**

Very similar to *bequaerti*, new species, but the abdomen opaque brown and black,

without shining areas, the ultimate section of the fourth vein is strongly curved, etc. Length, 6 mm.

MALE.—Front with yellowish pollen and a large, rectangular black spot below when seen from above; pollen of face yellowish white; head otherwise as in *bequaerti*.

Thorax and legs as in *bequaerti*, the scutellum with a few scattered hairs on the disc.

Wings light brown, paler posteriorly. Squamæ yellowish; halteres reddish yellow, the apex of the knob slightly browned.

Abdomen opaque; first segment, posterior half or more of the following segments, and the lateral margins cinnamon-brown; bases of the segments black, the black bands broadly produced in the middle almost to the apices of the segments; fifth segment rather shining on the apical half except laterally, the fourth and fifth with small yellowish-gray lateral spots. Genitalia black, moderately brown pollinose, the lamellæ hidden but probably very similar to those of *bequaerti*. Hair of abdomen sparse, conspicuous, the sides of the first segment with a row of coarse black hair.

HOLOTYPE.—Male, Lubutu, Belgian Congo, (J. Bequaert).

***Pipunculus pallidipleura*, new species**

Black, the abdomen shining; pleura luteous; antennæ yellow. Length, 4.75 mm.

MALE.—Eyes contiguous for a much longer distance than the length of the frontal triangle which is cinereous pollinose; vertical triangle black; face white, narrow; occiput brownish gray; anterior facets not greatly enlarged. Antennæ yellowish, the third segment short acuminate; arista black, yellow on the short, swollen basal portion.

Mesonotum black, thinly brown pollinose, the sides and pleura gray; broad lateral margins and the pleura luteous; pectus brown. Scutellum brown, with inconspicuous brown hair on the border.

Legs, including the coxæ, yellowish, the apical tarsal segment pale brown; pulvilli small. Hair of tibiæ yellow; the posterior pair swollen in the middle.

Wings tinged with grayish brown; anterior crossvein at basal third of discal cell; stigma brown; ultimate section of fourth vein gently bowed. Squamæ yellow; halteres reddish, with rusty brown apex to the knob.

Abdomen very shining, black, the sides of the second to fourth segments very broadly translucent brownish red; first segment gray; fifth large, broad, black; genitalia thinly brown pollinose, the outer forceps reddish, subtriangular, rounded apically. First segment without comb of black hair on sides.

HOLOTYPE.—Male, Mt. Ruwenzori, Congo, (2300 meters), (J. Bequaert).

***Pipunculus liberia*, new species**

Black, not shining; stigma complete, dark brown; antennæ black; femora black with reddish apex; wings cinereous hyaline. Length, 4.5 mm.

FEMALE.—Front narrow, with parallel sides, grayish-white pollinose on lower half, becoming brown pollinose above, shining behind the anterior ocellus; face narrow, silvery; occiput gray pollinose, brown on upper fifth. Antennæ black, the third segment long acuminate; thickening of arista about four times as long as its thickness.

Thorax brown pollinose above, almost black on the median third or more, the sides in front of the suture broadly gray; humeri yellowish. Pleura grayish pollinose,

a very broad band occupying the upper half from the middle of the mesopleura to the posterior margin of the thorax, brown. Scutellum blackish brown, bare.

Legs: trochanters, apices of femora, tips of tibiae and their basal two-thirds and the basal four tarsal segments, reddish; femora black, grayish pollinose, polished beneath, the hind pair polished behind; apical third of tibiae and the fifth tarsal segment, black; pulvilli very large, orange; claws long, orange with black tips.

Veins blackish, yellowish brown at base; anterior crossvein situated behind tip of auxilliary vein, somewhat before the middle of the discal cell; ultimate section of fourth vein rather gently curved, the apical cell narrow at tip. Squamæ whitish yellow. Halteres reddish, with brown tinge, the knob partly reddish brown.

Abdomen dull brownish black, the tips of the segments extremely narrowly pale, each segment on either side behind with a transverse, gray pollinose spot, the spots on the fifth segment occupying the posterior third, those on the preceding segments successively narrower; the spots on the sixth segment large, oval, or at least a little longer than wide, longitudinally placed; the first segment grayish, the base of the second more or less grayish in some views. Basal segment of ovipositor thinly gray pollinose, the second segment shining brown, the piercer reddish, reaching to the base of the second segment. Sides of first segment with comb of black hairs.

HOLOTYPE.—Female, Paiata, Liberia, October, 1926, (J. Bequaert).

The species comes closest to *katonæ* Kertész but differs in the color of the legs, in having very large pulvilli, the very narrow pale segmental apices, etc. From *trochanteratus* Becker it differs in having gray spots on the second to fifth segments, more than the basal half of the tibiae yellowish and longer, red (not black) piercer.

Syrphidæ

Microdon bequaerti, new species

Front of male at narrowest point not as wide as ocellar triangle; first antennal segment almost as long as the following two combined; thorax and scutellum with golden pile; scutellum with strong spines. Length, 12 to 15 mm.

MALE.—Head brownish or ferruginous, the sides of the face very broadly reddish or brownish red; pile of head pale yellowish, of occiput and front with golden tinge and more reddish, a few black hairs on the ocellar triangle which is moderately large, equilateral and situated in the middle of the upper section of the front. Antennæ elongate, black, the first two segments with black hair, the third with parallel sides on the basal four-fifths, sharply rounded at upper apex; arista as long as third segment, reddish.

Thorax ferruginous or brownish red, the disc mostly black with a pair of broadly separated, slender lines on the dorsum, the borders of the mesonotum and the scutellum wholly reddish. Pile golden reddish, some black hair on the mesopleura; plumula, fringe of posterior spiracle and the long pubescence on the metapleura, brown.

Legs brown or ferruginous, black-haired; the hair thick on the tibiae, partly reddish on the front pair; tarsi reddish, with golden hair, the posterior basitarsi very much swollen, almost cylindrical.

Wings brownish, the posterior half except broadly along the veins brownish gray or pale brown, the wings more or less luteous basally; anterior crossvein at basal

fourth of discal cell; apical crossvein recurrent, gently bowed. Squamæ pale yellowish, with golden-yellow fringe; halteres yellow.

Abdomen dark reddish, the fifth segment, the sides of the fourth very broadly, and the apical half of the second sublaterally, brownish black, the broad middle line also blackish as far forward as the middle of the second segment. First and second segments yellow pilose, the second with some black pile posteriorly towards the sides; third segment with short, black pile, across the middle with a narrow, interrupted band of tawny pile which broadens out to form triangles on the posterior half laterally; an arch extending forward from the anterior part of the fifth segment to the posterior third of the fourth and the very broad apex of the fourth, less broadly so laterally, tawny pilose, the sides of the abdomen wholly tawny or golden-reddish pilose. Venter reddish, broadly black laterally. Genitalia ferruginous. Abdomen robust, broad basally, hardly half longer than wide.

Female.—Front widening from vertex to below level of antennæ, brownish with the orbits and median vitta reddish; pile yellowish, a band of black hair across the ocelli, face pale yellowish, the cheeks darker; first antennal segment somewhat reddish basally; thorax paler and with yellowish pile; basal segment of posterior tarsi not swollen. First two abdominal segments pale brownish yellow, yellow-haired; apical three segments black, black-haired, each with a very broad band of yellow pile, that on the fourth produced subtriangularly forwards to the middle of the segment; sides of abdomen pale-haired except towards the posterior margin of the fourth segment.

HOLOTYPE male, ALLOTYPE female, and PARATYPE female, Gbanga, Liberia, September, 1926, (J. Bequaert).

***Microdon liberiensis*, new species**

Metallic greenish blue, rather thickly pilose; antennæ very short; abdomen almost circular in outline from dorsal view; scutellum deeply emarginate apically but without distinct spines. Length, 6.5 to 8 mm.

Male.—Face and front narrow, the front narrowing from the vertex to the anterior third, where it is less than half as wide as at vertex, the moderately large ocellar triangle situated at the upper third of the front; face widest just below the antennæ, in profile gently convex, most prominent above, thickly white pilose. Occiput with white pile, the front with a few white hairs in front of and opposite the ocelli; pile of front black. Antennæ black, the basal two segments with black hair; the third segment brownish, gently convex below, strongly oblique on lower apex, scarcely twice as long as wide; first segment slightly longer than following two combined; arista about as long as third segment; whole antenna not nearly as long as length of head.

Thorax clothed with brassy yellow pile; humeri brownish red, the pleura ferruginous or brown with more or less metallic green tinge, the incisures more or less broadly brownish yellow.

Coxæ brown, black-haired, the posterior pair whitish haired. Femora black, their tips reddish, the hair black, the apices narrowly yellow-haired. Tibiæ yellow on basal half or more, black apically, the pile white, black only on the under surface of the apical third of the middle tibiæ and the anterior surface of the apical half of the posterior tibiæ. Tarsi brown, black-haired, the first segment of the posterior pair not swollen.

Wings strongly tinged with brownish gray, the crossveins clouded with brown; apical crossvein recurrent, almost straight; anterior crossvein situated at basal fifth of discal cell. Squamæ, their fringe and the halteres pale yellow.

Second abdominal segment about half brownish yellow or luteous, the posterior border, median vitta and the very broad sides metallic, the pale color variable in extent, sometimes less extensive, sometimes covering almost all the segment and spreading on to the third segment. The pile is yellowish on the basal two segments; on the second there is a rectangular patch of outwardly directed pile on either side of the median line, while posteriorly in the slightly impressed sublateral depressions there is a triangular patch of pile which is directed inward and backward. Pile of third segment black, the posterior third with a broadly interrupted band of whitish pile, the basal corners with a small triangle of yellowish-white hair. Posterior half of the fourth segment, broadly interrupted in the middle, and the lateral borders, white pilose, the pile elsewhere black. Genitalia brownish. Pile of venter whitish.

♀.—The single female is teneral and does not exhibit the contrasting colors of the males. The face and front are mostly reddish in the specimen (an abnormal coloration), the face below and the vertex of about equal width, the front slightly widening below. There are black hairs on the apical third of the scutellum, the sides of the mesonotum and the pleura. The broad sides of the second abdominal segment bear black hair; the whitish pilose band on the fourth segment is in the form of two transverse triangles which narrow inwardly, while the pale pile on the fifth segment is not interrupted in the middle. The pale pile reaches the lateral margins only on the third segment.

HOLOTYPE.—Male, Du River, Camp No. 3, Liberia. ALLOTYPE.—Female, Gbanga, Liberia, September, 1926. PARATYPES. Male, Lenga Town, Liberia, August 15, 1926 and male, Eden, Cameroons, (J. A. Reis). The first three specimens were collected by Dr. J. Bequaert.

***Microdon tenuifrons*, new species**

Very similar to *liberiensis* but the thorax is wholly black pilose, there are small spines on the scutellum, the wings are brown and the color darker, more steel-blue. Length, 9 mm.

♂.—Front at lower third half as wide as at vertex, the anterior ocellus situated at the middle of the front, the triangle with the sides about equal; face slightly narrowing below, gently convex, most prominent above, yellowish-white pilose, with brassy tinge, above and below with a few black hairs. Front and upper half of the occiput black-haired, the occiput below with pale yellowish pile. Antennæ as in *liberiensis*. Head black, the face bluish green.

Thorax steel-blue, the humeri and pleura brownish; hair wholly black, moderately long. Scutellum with a fairly deep apical emargination and on the angular corners with small spines. On the sternopleura above and the base of the scutellum there are yellow hairs.

Legs blackish brown, the basal half or more of the tibiae reddish yellow; hair black, abundant on the tibiae, shining yellow on the basal half of the tibiae and the posterior surface of the anterior four. Posterior basitarsi not swollen.

Abdomen reddish brown, on the third and fourth segments mostly metallic bluish in some lights. The pile is black, the apical fourth of third segment rather golden pilose on the lateral third, the fourth segment with a very large, subtriangular area

clothed with golden pile on either side of the apical half. Genitalia brownish. Venter black-haired. Second segment above more or less luteous towards the middle.

HOLOTYPE.—Male, Du River, Camp No. 3, Liberia, (J. Bequaert.)

***Microdon appendiculata*, new species**

Blackish, the abdomen either dull reddish or wholly black; antennæ elongate; bend of fourth and fifth veins with appendage. Belongs to the group in which the thorax and abdomen are rather narrow and in which there is only closely appressed pile on the body and appendages. Length, 8 to 10 mm.

MALE.—Front wide, at the lower fourth four-fifths as wide as at vertex; its sides gently concave above, the frontal depression gently arched forwards; ocellar triangle of moderate size, lying but little in front of the posterior corners of the eyes. Face slightly widening below, in profile gently convex, strongly so below. Pile of lower half of face and occiput, silvery white, elsewhere on the head brassy yellow. Antennæ black, the first segment more or less reddish on basal half; elongate, two-ninths longer than the head, the first segment scarcely as long as the third, slender, above with yellow, below with black appressed hair, the second segment with at most two or three pale hairs, the rest black; third segment with parallel sides on basal half, considerably widened apically, the apex obtusely rounded below; arista luteous, about half as long as third segment.

Thorax black, coarsely granulate dorsally, with strongly appressed golden pile which becomes almost whitish on the lower part of the pleura, the scutellum similarly clothed; its posterior border evenly convex.

Legs reddish brown, the posterior pair black; wholly clothed with very short, appressed white hair; posterior tibiæ strongly swollen on apical third, the first segment of their tarsi strongly swollen, the following segment moderately swollen.

Wings grayish, brownish on apical half in front of the fourth vein; apical section of fourth and fifth veins recurrent, somewhat bisinuate, with a short appendage at the posterior bend; anterior crossvein situated at basal fourth of discal cell. Squamæ white, with very short white fringe; halteres yellow.

Abdomen dull reddish, the first segment brown, the disc of the fourth and fifth segments more or less ferruginous. Pile rusty brown, the narrow apex of the second segment, the sublateral depressions, broad sides of the abdomen, a broad, widely interrupted band on the third segment, the apex of the fifth segment, extending broadly forward on the combined fourth and fifth segments, white pilose, a transverse band of white pile extending over the middle of the genitalia, which are otherwise black-haired.

FEMALE.—Front with parallel sides above, thence widening to below the antennæ; pile of head whitish, yellowish on the front and upper part of the occiput; no frontal depression; third antennal segment conspicuously wider apically; pile of thorax pale brassy yellow, on the mesonotum black except on the broad anterior and lateral borders, but with scattered yellow hairs on the disc; pile on basal half of scutellum largely black. Legs more brownish red. Apical two abdominal segments brownish; fourth segment with pale pile as on the combined fourth and fifth of the male, the fifth with lateral triangles resting on the base and extending to the apical corners and a rectangular spot on the apical half in the middle, white pilose.

In the black female the pile of the abdomen is colored as in the male, being only slightly paler on the head but there is black pile on the disc of the thorax and scutel-

lum; legs brown as in male; abdomen black, the second segment somewhat reddish laterally.

HOLOTYPE.—Male, Kakatown, Liberia, August 20, 1926. ALLOTYPE.—Female, Gbanga, Liberia, 1926. PARATYPE.—Female, Kakatown, August 20, 1926. All collected by Dr. J. Bequaert. The paratype is the dark female.

The variation in color is not unusual in this group but the difference in the structure of the third antennal segment may indicate specific differences, although it may be an abnormal condition.

***Microdon inappendiculata*, new species**

Structurally very similar to *appendiculata* but with the third antennal segment much shorter, no appendage at bend of fourth and fifth veins and wholly black in color in male. Length, 8.5 mm.

MALE.—Front very much narrower than face, at anterior third about two-thirds as wide as at posterior angles of the eyes, the posterior ocelli situated only slightly in front of posterior angles of eyes; face widest below, almost vertical on upper three-fifths, convex below. Pile of head whitish with slight brassy tinge, the vertex and ocellar triangle black-haired. Antennae long, blackish, the first segment as long as the two following, the third slightly more than three-fifths as long as the first, with almost parallel sides, slightly convex below, the apex obtusely rounded; second elongate; basal two segments with short black hair; arista two-thirds as long as third segment.

Thorax coarsely granular, the pile with scarcely any yellow tinge, whitish; a broad band on the mesonotum behind the suture and a transverse median spot immediately in front of the suture, black-haired.

Legs black, white-haired, the femora and apical tarsal segments with black hair; tarsi reddish, darker basally, the basal two segments of the posterior pair blackish; basal segment of posterior tarsi rather strongly swollen, the second segment moderately enlarged.

Wings cinereous hyaline, blackish gray on apical half in front, the veins clouded with gray. Apical and discal crossveins recurrent, without appendage behind. Squamæ and halteres white, the former with very short fringe.

Abdomen black, the pile arranged as in *appendiculata*, black and white. Second segment widest, with almost parallel sides, the sublateral depressions rather deep. Genitalia reddish, black-haired.

HOLOTYPE.—Male, Kakatown, Liberia, August 20, 1926, (J. Bequaert).

This species is very similar to the American forms belonging to the subgenus *Omegasyrphus* Lynch-Arribalzaga but the straight sides of the second abdominal segment distinguish it from that group. It seems to form definite connection between the group of which *appendiculata*, new species, is a representative and *Omegasyrphus*.

***Graptomyza breviscutum*, new species**

Related to *triangulifera* Bigot but with longer antennæ and the scutellum not one-third as long as wide. Length, 8.5 mm.

MALE.—Face and cheeks yellow, a very broad median vitta, a broad vitta separating the face and cheeks and the narrow oval margin, brown; occiput and front black, the front with a subtriangular yellow spot on either orbit above the middle and another below, confluent with the yellow color of the face. Pile yellowish, on the lower part of the front and the median facial vitta, black. Antennæ brown, longer than the face; arista brown, luteous basally, short plumose. Eyes sparsely pilose. Face not nearly as wide as either eye, in profile gently produced, the low tubercle conspicuous, the antennal base prominent.

Thorax black, the dorsum with metallic blue sheen; humeri, a spot above the front coxæ, a triangle extending inward along the suture and continued downwards along the anterior border of the mesopleura, the upper edge of the sternopleura, lateral margins narrowly above the wings, posterior calli, a broad prescutellar fascia and the apical two-thirds of the scutellum, yellow. Pile yellowish; a large patch of short black hair on either side behind the suture, the posterior fourth with scattered long black hair; bristles black. Base of scutellum black, the depression small and very deep, appearing as a distinct hole; scutellar hair yellow, the border with four or six black bristles.

Coxæ and anterior femora reddish brown, the femora becoming yellow at the apex; middle and hind femora black, the apex yellow, the base of the hind pair broadly yellow; pile of femora black, yellowish on the base of the posterior pair and lower edge of front pair; tibiæ yellow, yellow pilose, the posterior pair black except on the broad base, black pilose. Tarsi yellowish, the posterior pair with the first segment black-haired above; first segment of the middle tarsi greatly broadened, widest on basal half.

Wings cinereous hyaline; stigma pale luteous; a short brown band covering the base of the stigmal cell and extending across the marginal cell; a broad band or cloud extending backward from the apical half of the stigmal cell as far as the middle of the discal cell, extended apically to join a narrow band extending over the crossveins and across the submarginal cell, brown. Squamæ grayish yellow, the border yellow on lower lobe, brown on upper lobe, the fringe yellow; halteres reddish yellow.

Abdomen shining black, yellow pilose; lateral margins of first and second segments, a broad vitta on either side of the second and third segments extending from the base of the second to the middle of the third and the posterior border of the second segment between pale vittæ, reddish yellow, the apical fascia interrupted, the apex of the third segment more or less reddish in the middle. Fourth segment with erect black pile in addition to the pale hairs, the second and third segments each with a patch of black pile on either side of the median line. Venter yellowish with brown median vitta. Genitalia blackish.

HOLOTYPE.—Male, Lesse, Belgian Congo, July 21, 1924, at flowers of *Bidens pilosa*, (J. Bequaert).

***Baccha inversa*, new species**

Metallic blue-black; wings broad, blackish brown, posterior border narrowly gray on apical third. Length, about 10 mm.

FEMALE.—Face, occiput and vertex steel-blue; sides and upper third of face and lower three-fourths of occiput grayish pollinose and white pilose; occipital cilia on upper fourth brown; frontal hair, short, black, a few white hairs across the middle; a narrow, narrowly interrupted band of grayish pollen across the middle of the front.

Front moderately wide above, gradually widening from near the vertex to the antennæ, the supra-antennal swelling large, prominent, violaceous, the upper half of the front swollen and prominent, the ocelli situated far from the vertex. Anterior oral margin as prominent as antennal base, the tubercle large and prominent; lower edge of mouth strongly oblique on anterior four-fifths; antennæ reddish brown, the base of the third segment narrowly reddish yellow on lower half, the segment one-half longer than wide, sharply rounded above; arista yellow on basal two-fifths.

Mesonotum and scutellum rather dull black, thickly covered with fine punctures, the hair very short, black, a broad fascia of white hair before the scutellum. Scutellar fringe extremely short, white. Pleura bluish, white pilose.

Legs black; posterior tarsi reddish, the tips of the segments narrowly pale brown; apical segment of anterior four tarsi more or less reddish. Hair of legs extremely short, blackish, the middle femora with some long hair behind.

Alula very large, about one-third hyaline. Squamæ with broad white border and very short white fringe. Halteres whitish yellow.

Abdomen shining bluish black; third and fourth segments with a broad median and sublateral bronzed vitta, the lateral vitta produced broadly to the lateral margin posteriorly on each segment, those on the third segment tapering anteriorly. Hair black, on the apex of the second segment and the bluish parts of the third and following segments, white, the lateral margins, however, wholly black-haired. The abdomen is moderately pedunculate, the second and third segments long, the second slightly longer than the third.

HOLOTYPE.—Female, Lésse, Congo, July 21, 1914, (J. Bequaert).

***Baccha nitidithorax*, new species**

Black, the antennæ and legs in part reddish; wings pale brownish, hyaline on basal third. Length, 9 mm.

MALE.—Face, cheeks and occiput steel-blue, grayish pollinose; white pilose; upper third of occiput, frontal and vertical triangles, blue-black; facial tubercle bare apically. Eyes touching for a distance equal to two-thirds the length of the frontal triangle, which is gently swollen on the lower two-thirds and bears a small gray pollinose spot above; ocellar triangle small, occupying less than the anterior half of the vertical triangle. Anterior oral margin less prominent than the antennal base, the tubercle large and prominent; lower edge of mouth strongly oblique, slightly convex in profile. Antennæ brownish red, the third segment short oval.

Mesonotum and a fascia on the pleura beneath the wings shining black, the mesonotum somewhat bronzed, scarcely dulled on the disc; pile brown, rather short; on the pleura and scutellum yellowish. Pleura grayish pollinose; sides of mesonotum in front of the suture æneous; ventral scutellar fringe cinereous.

Legs black; apices of the femora and of the anterior four tibiae, basal half of anterior four tibiae, basal fourth of the posterior pair and the first segment of all the tarsi, reddish yellow, the tarsi pale yellowish-brown. Hair black; on the anterior four tibiae and the first segment of all the tarsi, yellow.

Wings pale brown, hyaline on basal fourth; stigma brownish luteous. Alula large. Squamæ and fringe brown; halteres pale yellow.

Abdomen shining metallic black, slightly bronzed, the apical fourth of the second, half of the third and a broad band across the middle of the fourth segment, opaque. Pile on the first segment, basal half of third and on large triangles on the base of the

fourth, white, elsewhere black; appressed on the dorsum. Genitalia small, blue-black. Second and third segments long, the second very narrow, the third hardly three-fourths as long as the second, the apical segments moderately widened.

HOLOTYPE.—Male, Lésse, Congo, July 21, 1914, (J. Bequaert).

This species is readily distinguished from *bequaerti* and *liberia* by much longer second and third abdominal segments, shining thorax, etc.

***Baccha bequaerti*, new species**

Black, antennæ and legs in part reddish; wings pale brown, hyaline subbasally. Length, 8 mm.

MALE.—Head steel-blue, the front bronzed, small spot in the upper angle gray pollinose. Pile black, on the lower two-thirds of the occiput, white; sides of face and occiput gray pollinose, the latter shining above; eyes touching for a distance equal to the length of the frontal triangle, the upper facets swollen; ocellar triangle occupying the anterior half of the small vertical triangle, the hairs in a single row. Frontal triangle moderately swollen above the lunula. Face below slightly more prominent than at the antennal base, the tubercle large and prominent; lower edge of mouth oblique. Antennæ brown, reddish below, the third segment somewhat longer than wide, obtusely rounded apically.

Thorax æneous, the dorsum dulled and more blackish, the sides behind the suture black; pleura with a black fascia beneath the wings. Pile on median third of mesonotum, pleura and dorsum of scutellum, yellowish; on the pteropleura, upper, posterior border of mesopleura and the broad margin of the scutellum, black. Scutellar fringe yellowish.

Legs black, the apices of the femora, broad bases of the tibiæ and the apices of the anterior four tibiæ, reddish; basal tarsal segment reddish brown. Pile black; yellowish on the anterior tibiæ.

Wings pale brownish, the immediate base brown; the color becomes almost hyaline towards the basal sixth. Alulae large. Squamæ and fringe brown. Halteres yellow.

Abdomen shining greenish-black, the apical two-thirds of the second and large, subtriangular spots on the apical half of the third and fourth segments, opaque. Pile wholly black, long on the sides basally, appressed dorsally. Genitalia small, shining black. Second abdominal segment four-fifths as long as the third. The abdomen is moderately slender, narrowest at the middle of the second segment.

HOLOTYPE.—Male, Eden, Cameroon, (J. A. Reis).

Looks very much like *B. liberia* but the shorter abdominal segment, shorter abdominal petiole and the brown squamæ at once distinguish it.

***Baccha liberia*, new species**

Black, the antennæ and legs partly reddish, wings grayish, hyaline on basal fourth. Length, 11 mm.

MALE.—Head steel-blue, the facial tubercle and frontal triangle black, the latter slightly bronzed; upper fourth of front, face, cheeks and occiput grayish pollinose. Pile black, yellow on the cheeks and lower half of occiput; occipital cilia brown on upper third, white below. Eyes touching for a distance almost equal to the length of

the frontal triangle; ocellar triangle situated at front of vertical triangle; lower two-thirds of frontal triangle swollen; oral margin slightly more prominent than the antennal base, the tubercle long and prominent; lower edge of head oblique. Antennæ brown, the lower surface of the first two and broad base of the third segment, except above, reddish; the third segment oval, rounded apically; arista shorter than antenna, luteous on basal half.

Thorax rather bronzed, the dorsum dulled by brown pollen, the pleura gray pollinose except a fascia beneath the base of the wings. Pile of the dorsum, pteropleura and upper border of the mesopleura, blackish or brown, on the pleura and scutellum, yellowish, the latter with some black hairs apically, the ventral fringe yellowish.

Legs blackish; tips of femora, broad bases of the tibiae, the middle pair almost wholly, and the basal tarsal segment, brownish yellow, the hair black.

Wings brownish gray, the basal fourth hyaline; the base of the wing before the humeral crossvein, and the stigma, luteous; alula large. Squamæ and fringe white; halteres pale yellow.

Abdomen shining blue-black, the apical half of the second and third segments opaque, the third more or less broadly shining in the middle posteriorly. First segment, sides of second on basal two-thirds and small lateral triangles on the third, long, whitish pilose, the basal third of the second segment and a small, submedian triangle on either side of the third, with shorter white pile. Pile elsewhere black, long basally on the sides, short and appressed dorsally beyond the middle of the second segment. Genitalia small, rather brownish. Abdomen rather strongly petiolate, the second segment scarcely longer than the third.

HOLOTYPE.—Male, Memel Town, Liberia, August 29, 1926, (J. Bequaert).

***Rhingia trivittata*, new species**

Related to *mecynata* Speiser but the thorax bears three broad dark-brown vittæ, the snout is brown above, etc. Length, including snout, 11 mm.

MALE.—Face and cheeks yellowish, middle of face, upper surface and tip of snout, the occiput and front brown in ground color, pile yellowish on cheeks and occiput, occipital cilia and frontal pile black; frontal triangle and cheeks bare; sides of face, the cheeks and occiput, whitish-gray pollinose; frontal triangle with the border clothed with grayish-yellow pollen, the ocellar triangle gray. Proboscis blackish. Antennæ reddish, the third segment darker, sometimes brown, three-fourths as wide as long, rather pointed apically; arista shining brown or black.

Mesonotum with more than the median half brown in ground color, the sides and posterior border broadly reddish; a broad median and a slightly narrower vitta on either side with brown pollen, the pollen elsewhere on the thorax grayish red. Pile black on the dorsum, partly yellow in front of the suture and wholly so on the pleura. Scutellum shining reddish, the pile black, a narrow basal band and the long ventral fringe pale yellowish. Pleural incisures broadly reddish.

Legs reddish, the femora more or less brown basally, the apical four tarsal segments somewhat brown at the base. Hair black, the posterior surface of the anterior four femora with long pale hair on basal half or more, the posterior femora with pale hair on basal three-fourths of anterior and posterior surfaces.

Wings with yellowish brown or luteous tinge. Squamæ yellowish gray, with brown border and fringe; halteres reddish with brownish-tinged knob.

Abdomen reddish and shining black; basal segment reddish yellow, the posterior incisure shining black except in the middle; second segment reddish with the apical sixth or less black; third segment with a black band occupying the apical third, the band with small triangular excision at middle and sides; in front with the base very narrowly brown toward either side. Fourth segment black with indications of reddish spots on anterior corners. Abdominal pile black, yellowish on the lateral margin, on the basal half of the second and whole of the first segment. Genitalia brownish, with reddish tinge basally, the pile black.

HOLOTYPE.—Male, S. W. Mikenò, Belgian Congo, March, 1927. PARATYPE.—Male, Kibotì, Congo, March 28, 1927. Both specimens collected by Dr. J. Bequaert.

***Lejops nasutus*, new species**

Related to *lineata* Linnæus but with a longer snout, more curved posterior tibiæ, etc. Length, including snout, 1.05 mm.

MALE.—Head black, the face, cheeks, occiput and lower part of front thickly brownish-yellow pollinose with golden tinge; vertical triangle with yellowish-brown pollen in front of the ocelli, brownish on posterior half. Front strongly narrowed at anterior third where it is much narrower than the width of the second antennal segment; ocellar triangle much wider than long. Snout very long, horizontal, shining black on lower half, the line of demarkation between the upper and lower sections of the front also shining. Occipital cilia, frontal pile and hair on upper part of snout, black, elsewhere yellowish white. Antennæ black; third segment subrectangular, a little longer than wide; arista brownish red, longer than antenna.

Mesonotum grayish-brown pollinose, with a pair of widely separated, moderately broad, entire dull ochreous vittæ which are narrowly bordered with black; pleura brownish-gray pollinose. Median three-fifths of mesonotum with extremely short black hair, the sides and pleura pale-yellowish pilose. Scutellum black, moderately brown pollinose, white pilose, the hair very short except on the free border.

Legs black, chiefly yellowish pilose; tips of femora and bases of tibiæ, reddish, broad apices of the anterior four tibiæ and the basal three segments of their tarsi, yellow; third segment of posterior tarsi reddish, the preceding segment partly reddish. Anterior and middle femora with short black hair on anterior surface, the posterior tibiæ black-haired on basal half. Posterior femora moderately swollen, their tibiæ rather strongly arcuate, produced on the inner apex as a broad, yellowish lobe, the basal segment of their tarsi swollen. Anterior tarsi with a small black spot near the middle below.

Wings strongly tinged with brownish yellow. Squamæ and halteres yellow.

Abdomen black, with two pairs of yellow triangles, mostly opaque. First segment grayish pollinose; second with a pair of large yellowish triangles extending from the base to the apical fifth, their inner ends sharply rounded, broadly separated from each other; the apical fifth of the segment shining black. Third segment with a pair of large, transverse, broadly separated semioval spots on the basal half, the ochreous pollen covering them acute inwardly, the apical fourth of the segment shining black. Fourth segment with a pair of brownish-ochreous pollinose spots which are obliquely placed, their outer ends rounded, their sides almost parallel, the inner ends resting wholly on the base of the segment and broadly separated from each other, the posterior half of the segment and the broad lateral margins shining black. Genitalia

shining black. Pile pale yellowish, on the incomplete, narrow apex of the second segment, on the apical half of the third except laterally and the middle of the fourth, produced broadly towards the sides on the posterior half, black. Venter thinly gray pollinose, pale pilose.

HOLOTYPE.—Male, Masisi, Belgian Congo, December 30, 1914, (J. Bequaert).

Diopsidæ

Diopsis dimidiata, new species

Related to *ichneumonea* Linné, but with the basal third of the abdomen black and the front with an oval tubercle in front of the ocelli, radiating fine ridges on either side and with granular median area. Length, 6 to 6.5 mm.

MALE.—Head shining rusty reddish, the eye-stalks posteriorly and apically and the V separating the front and face, blackish. Median bristle on eye-stalks very small arising from a tubercle, the ocular bristle small. Hair sparse. Oral spines small, oblique. The lateral ridges on the front radiate from a point almost opposite the ocelli to the lunular groove, the inner lower ones being more conspicuous. Palpi and antennæ reddish.

Thorax moderately gray pollinose, the sides of the collar and dorsum of the scutellum except the base and a narrow median vitta, shining black, the scutellum very finely granulate. Thoracal and scutellar spines reddish, with the tips broadly black. Hair inconspicuous.

Legs, including the coxæ, reddish yellow; femora with the subapical half ferruginous, sometimes paler below, somewhat variable in extent and intensity of the color; anterior and posterior tibiæ ferruginous or brownish; tarsi becoming brown apically, the anterior pair brown except at the base; middle tibiæ often with ferruginous tinge. Anterior femora strongly swollen.

Wings grayish hyaline, with a narrow subapical spot extending from the costa almost to the fourth vein, the disc of the wing rarely a little darkened.

Abdomen shining black, the fourth segment with a median gray pollinose vitta, the subapical half of the second segment (actually almost the apical half of the second and basal two-thirds of the third, the segments fused) deep reddish, the broad middle of the third and fourth segments sometimes reddish or with castaneous reddish tinge. Abdomen moderately clubbed.

FEMALE.—Abdomen wider, with broader reddish bands.

HOLOTYPE male, ALLOTYPE female, Pretoria, S. Africa, April 26, 1919. PARATYPES: six males one female, same data; male, Elliot, May 11, 1924, and male, East London, April 23, 1922. All collected by Mr. H. K. Munro. Types in Munro Collection; paratypes in American Museum of Natural History.

This species closely resembles the form described by Eggers as *D. ichneumonea ichneumonella*, but that insect has the front polished.

Diopsis munroi, new species

Black, the wings brown, the basal fourth hyaline, three fasciæ whitish. Length, 7 mm.

MALE AND FEMALE.—Head brownish black, the sides gray pollinose, hair not abundant, rather short; front with the median third smooth, the sides with three or four low, transverse ridges. Eye-stalks short, without bristles; antennæ brown.

Anterior third of mesonotum, the pleura and scutellum wholly, rather thinly gray pollinose; hair inconspicuous. Scutellar spines brown, sparsely pale-haired, one-half longer than scutellum. Spines of thorax brown.

Legs castaneous, the tarsi reddish.

Basal fourth of wings hyaline, the apical three-fourths brown, pale apically and posteriorly. A broadly interrupted, slightly curved white fascia lies a little before the middle of the wing; a second, outwardly bowed white fascia begins in the apex of the marginal cell and extends to the posterior border of the wing behind the tip of the second vein, being narrowly interrupted at the third vein; narrowly separated from this fascia is a less distinct and more irregular one, beyond which the color is paler.

Abdomen shining black, the sides of the second and third segments with small triangular gray pollinose spots.

HOLOTYPE male, ALLOTYPE female, Fairy Glen, Pretoria, March 29, 1913. PARATYPES.—Male, same data; three females, Premier Mine, May 11, 1914, all collected by H. K. Munro. Types in Munro Collection; paratypes in American Museum of Natural History.

Tachinidæ

BEQUAERTIANA, new genus

Readily distinguished from described genera by the absence of the apical half of the ultimate section of the fourth vein, absence of the postscutellum, very long pubescent arista and the short antennæ; belongs to the Moriniinæ.

Cheeks slightly over three-fifths as wide as eye-height; face in profile rather strongly convex-receding to lower edge of eyes, thence vertical to oral margin the soft part of the cheeks very wide; parafacials with short, bristly hairs on whole length; front with parallel sides, three-fourths as wide as either eye, (from frontal view one-sixth wider than eye); parafrontals with row of ten to twelve rather weak orbitals, the upper three or four pairs divergent; twelve pairs of frontals, none below the base of the antennæ; ocellars absent, the ocellar triangle with longish hair; frontal vitta slightly narrower than either parafrontal. Antennæ short, lying in the short-oval facial depression which extends two-thirds the distance to the oral margin, the third segment not larger than the second; arista dorsal, very long pubescent; three pairs of strong bristly hairs and several weaker ones along the sides of the narrowed clypeal regions. Mouthparts small, the palpi, if present, wholly concealed. Hair of thorax moderately short, not abundant, the acrostical hairs in two rows; dorsocentrals 1-3; no intra-alars; one supra-alar; presutural strong; no posthumeral or sublaterals; two notopleurals and one or two humerals; two bristles on the posterior calli; scutellum with two pairs of bristles, the hair rather long; two sternopleurals and several scattered hairs; two to four hypopleural bristles. Postscutellum not convex. Legs almost without bristles, the anterior femora with a row of bristly hairs on the apical two-thirds of the posteroventral surface, the posterior femora with one or two weak bristles on the posteroventral surface near the middle. Claws and pulvilli small. First vein of wings setose on whole length; fourth vein straight, not nearly reaching the wing margin; posterior crossvein straight, transverse; anterior crossvein beyond middle of discal cell; no bristles on third vein. Squamæ long and narrow, rounded apically; no infrasquamal setulæ. Abdomen twice as long as wide, its sides almost

parallel beyond the first segment, obtuse apically, flattened and very much wider than deep, without bristles.

GENOTYPE.—*Bequaertiana argyriventris*, new species.

***Bequaertiana argyriventris*, new species**

Brownish yellow, the head and legs partly black; abdomen silvery in some views. Length, 6.5 mm.

MALE.—Occiput below the neck and the facial depression brownish yellow, the face and cheeks brown, brownish-gray pollinose. Occiput and front black, the former and the outer half of the parafrontals with rather thin brownish-gray pollen; frontal vitta blackish. Antennæ yellow, the arista black.

Mesonotum rather silvery, with three broad, almost bare vittæ; pleura thinly whitish pollinose.

Femora with brownish tinge apically, the tibiæ and tarsi black.

Wings gray. Squamæ grayish yellow, with narrow brownish border. Halteres broken off.

Abdomen with the posterior third to one-half of the segments brownish; from most views silvery beyond the first segment. Hair black. Venter yellow, the fifth sternite with a brown band. Genitalia not visible from dorsal view, rather small.

HOLOTYPE.—Male, Du River, Camp No. 3, Liberia, (J. Bequaert).

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BY FRANK M. CHAPMAN

In July, 1927, the Museum despatched an expedition to Mt. Roraima under the patronage of Mr. Lee Garnet Day of New York City and the leadership of Mr. Geo. H. H. Tate of the Museum staff. The expedition returned to New York, February 15, 1928, with 1260 birds secured chiefly by Mr. T. D. Carter of the Museum staff, and also collections of mammals made by Mr. Tate.

A study of the birds, and particularly of their distribution in connection with that of their allies, has revealed a number of definite facts of exceptional interest but most difficult of interpretation.

Meanwhile, under the patronage of Mr. Sidney F. Tyler, Jr., the Museum has sent an expedition to Mt. Duida, also led by Mr. Tate. Mt. Roraima, it will be remembered, is at the junction of Brazil, British Guiana and Venezuela, while Duida is at the western end of the range with which Roraima is associated.

In the hope that collections from the higher portions of the Duida group will throw some light on the problems presented by a study of the life of Roraima it has been considered advisable to defer a full report on the Roraima collections until those from Duida are received. Pending their arrival I present the following descriptions of new forms, including a remarkably distinct flycatcher, secured by the Day Expedition.

In the belief that Mt. Roraima constitutes the larger part if not entire range of the birds here described, I make no apology for frequent use of the name *roraimæ*.

The color terms employed are, as usual in the publications of the Department of Birds, from Ridgway.¹

***Columba albilinea roraimæ*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Columba albilinea albilinea* Bonaparte of the Subtropical and Temperate zones of the northern Andes but rump and upper tail-coverts much darker and strongly washed with the metallic olive-green of the back; the rectrices much darker, the black subterminal band much more pronounced and

¹Color Standards.

showing distinctly from above, the terminal band more slaty, deep mouse-gray, rather than mouse-gray; wing-quills and coverts darker, the underparts deeper, less glaucous.

TYPE.—No. 236,495, Amer. Mus. Nat. Hist.; ♂ ad.; Philipp Camp, alt. 6000 ft. Roraima, Venezuela; November 7, 1927; T. D. Carter.

SPECIMENS EXAMINED

Columba albilinea roraimæ.—VENEZUELA: Philipp Camp, 6000 ft., Roraima, 2 ♂ ad., 2 ♀ ad.; Rondon Camp, 6800 ft., Roraima, 1 ♂ im.

Columba albilinea albilinea.—COLOMBIA, 27. ECUADOR, 8.

This well-marked race is known only from the Subtropical Zone of Roraima. Here it is apparently widely separated from its species, the nearest point from which true *albilinea* has been recorded being the Cumbre of Valencia in northern Venezuela.¹ Thence it extends through the subtropics to Costa Rica and Bolivia.

Systellura ruficervix roraimæ, new subspecies

SUBSPECIFIC CHARACTERS.—Similar to *Systellura ruficervix ruficervix* (Selater) but larger and darker, the whitish markings fewer; the brownish markings of the rump, upper tail-coverts, wing-coverts and tertials reduced in area and darker, tawny rather than ochraceous-tawny; mottled grayish bars on the central rectrices narrower than intervening black areas; white marking on the four outer primaries not an unbroken bar, the white spots on the web of each feather either not reaching to the shaft or separated by the black, instead of white, shaft; bend of the wing and a small mark on the outer web of the longest alula ochraceous-buff or tawny instead of white. Two males measure: wing, 167, 168; tail, 111, 111 mm.; five males of *r. ruficervix* from Colombia measure: wing, 152, 153, 156, 159, 161; tail, 106, 103, 109, 111, 112 mm.

TYPE.—No. 236,552, Amer. Mus. Nat. Hist.; ♂ ad.; Philipp Camp, alt. 6000 ft., Mt. Roraima, Venezuela; November 11, 1927; T. D. Carter.

SPECIMENS EXAMINED

Systellura ruficervix roraimæ.—VENEZUELA: Roraima, Philipp Camp, alt. 6000 ft., 2 ♂.

Systellura ruficervix ruficervix.—VENEZUELA: Mérida region, 5 ♂, 3 ♀. COLOMBIA, 8 ♂, 5 ♀. ECUADOR, 3 ♂, 3 ♀.

The nearest point to Mt. Roraima from which *Systellura ruficervix* has been recorded is the Mérida region of Venezuela. Here it is found in the Temperate Zone and it occurs in this zone southward to Bolivia. The Roraiman form is, therefore, completely isolated from its nearest relative.

¹Hellmayr and Seilern, 1912, Archiv für Naturg., LXXVIII, p. 159.

Trogonurus personatus roraimæ, new subspecies

SUBSPECIFIC CHARACTERS.—Similar to *Trogonurus personatus personatus* (Gould) of the Andean Subtropical Zone but central tail-feathers deep coppery-bronze instead of brassy-green; the crown, nape, back and breast more brassy, the white bars of the rectrices slightly wider, the black ones correspondingly narrower; size slightly smaller; 3 ♂; wing, 116, 120, 120 mm.; tail, 139, 140, 142 mm.

TYPE.—No. 236,600, Amer. Mus. Nat. Hist.; ♂ ad.; Rondon Camp, alt. 6800 ft., Mt. Roraima, Venezuela; December 2, 1927; T. D. Carter.

SPECIMENS EXAMINED

Trogonurus personatus roraimæ.—VENEZUELA: Mt. Roraima; above Paulo, between 5000 and 6000 ft., 1 ♂; Philipp Camp, 6000 ft., 1 ♂; Rondon Camp, 6800 ft., 1 ♂.

Trogonurus personatus personatus and *personatus assimilis*.—VENEZUELA: Mérida region, 2 ♂. COLOMBIA AND ECUADOR, 9 ♂, 9 ♀.

Eight of our nine males of *p. personatus* and *p. assimilis* show little variation in the general color of the upperparts and tail; the ninth, from El Eden in the central Andes of Colombia, is one of the brassy plumaged birds which seem almost to mark a color phase in trogons. It alone approaches *roraimæ* but the tail is brassy rather than bronzy.

The nearest point to Mt. Roraima from which *personatus* is known is the Mérida region of western Venezuela.

Elænia dayi, new species

SPECIFIC CHARACTERS.—The largest and darkest species of the genus; wings of about the same length as tail, proportionately shorter and more rounded than in typical *Elænia*.

TYPE.—No. 236,810, Amer. Mus. Nat. Hist.; ♀ ad.; summit of Mt. Roraima, 8600 ft., Venezuela; November 18, 1927; T. D. Carter.

DESCRIPTION OF TYPE.—Upperparts olivaceous chestnut drab, the crown chestnut black; upper tail-coverts chestnut drab, tail fuscous-black, the extreme tips of the feathers rusty; wings and their upper coverts fuscous-black; the inner quills margined externally with pale yellowish white, the lesser coverts broadly tipped on both webs, the greater covert on the outer web with soiled grayish white; bend of the wing yellowish; underparts citrine drab darker on the breast and sides, the chin paler, the center of the abdomen more yellow, under tail-coverts tinged with buffy brown; feet and bill black, the mandible brownish basally.

This remarkable new flycatcher is so unlike any recognized species that it is not possible to name with certainty its nearest relative. Geographically it is nearest *Elænia flavogaster flavogaster* of the slopes of Roraima; in color and in proportions it is nearest *Elænia obscura* of the Subtropical Zone of Peru and Bolivia. When compared with the species of *Elænia* that most closely approach it in size it will be observed that there is pronounced difference in the shape of the wing, the tail being

longer, the wing more rounded in *dayi*. These differences might be considered of generic value did they not largely disappear on comparison of *dayi* with *obscura*; and the fact that in color also *dayi* is nearest *obscura* suggests that, as in some other cases, the closest relative of the Roraiman bird is to be found in the Andes. But, whatever be its relationships, *dayi* agrees with *Brachyospiza capensis macconnelli*, also resident on the summit of Roraima, in being markedly larger and darker than any other species in its genus.

MEASUREMENTS

Name		Sex	Wing	Tail	Tarsus	Culmen	Longest Primary Longer Than Innermost
<i>Elania dayi</i>	Summit of Roraima	♀	91	89	22	15	11
" <i>o. obscura</i>	Bolivia, 7700 ft.	♀	80	77	21	14	12
" " "	" "	♂	82	77	20.5	14	13
" <i>gigas</i>	E. Ecuador	♀	93	77	20	14	17
" <i>f. flavogaster</i>	Rio Janeiro	♂	77	66	20	12	16
" " " "	" "	♂	80	67	20	13	15.5
" " " "	" "	♀	77	66	20	12	15.5
" " " "	Philipp Camp, Roraima	♂	85	76	20	15	14
" " " "	" " "	♀	79	72	20	14	14
" <i>spectabilis</i>	N. Argentina	♀	89	74	22	13.0	17
" <i>pelzelni</i>	L. Amazon	♂	89	73	21	15	16.5

In naming this species after Mr. Lee Garnet Day of New York City, I pay a well-deserved tribute to him, not alone for the support which made our Roraima expedition possible, but for the interest he has long shown in the American Museum.

***Compsothlypis pitiaiyumi roraimæ*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Compsothlypis pitiaiyumi elegans* Todd, of northern South America, but with the dorsal patch smaller and darker, the white tail-spots smaller, the flanks tinged with olivaceous, the mandible basally horn, terminally black; tarsi black; the toes dark brown, their soles paler.

TYPE.—No. 237,071, Amer. Mus. Nat. Hist.; ♂ ad.; Arabupu, alt. 4200 ft., Roraima, Venezuela; January 7, 1928; T. D. Carter.

SPECIMENS EXAMINED

Compsothlypis pitiayumi roraimæ.—VENEZUELA: Roraima; Arabupu, 1 ♀; Paulo, 1 ♂.

Compsothlypis pitiayumi.—Other races; adequate series (see Amer. Mus. Novitates, 1924, No. 143, p. 2).

Compsothlypis pitiayumi is, generally speaking, a subtropical species which at the northern and southern limits of its range in subtropical latitudes, and locally elsewhere, occurs at sea-level.¹ In Guiana it is known only from Roraima, but *C. p. elegans* occurs in Trinidad, north-eastern Venezuela, central Venezuela and Colombia, whence other races carry the species south on the Andes to Argentina and north, chiefly in the mountains, to Texas.

One of our two Roraiman birds agrees with average specimens of *elegans* in the color of the underparts; the second specimen has the breast ochraceous-tawny. It is probably one of the highly colored individuals that sometimes occur in this species, but in our large series it cannot be matched, though it is approached by several specimens of *pacifica*.

***Brachyspiza capensis roraimæ*, new subspecies**

SUBSPECIFIC CHARACTERS.—Agrees with *Brachyspiza capensis macconnelli* Sharpe of the summit of Roraima and differs from other races of this species in having the wing short and rounded, the rump and flanks and sides gray, without brownish wash; differs from *B. c. macconnelli* in being smaller and having the black areas more restricted, the gray center of crown averaging as broad as the black lateral stripes instead of being nearly obscured by black.

TYPE.—No. 237,162, Amer. Mus. Nat. Hist.; ♂ ad.; Philipp Camp, 6000 ft., Roraima, Venezuela; November 9, 1927; T. D. Carter.

SPECIMENS EXAMINED

Brachyspiza capensis roraimæ.—VENEZUELA: Roraima; Paulo, 1 ♂, 2 ♂ juv., 1 ♀ juv.; Philipp Camp, 13 ♂, 8 ♀, 3 ♂ juv.; Rondon Camp, 5 ♂, 5 ♀, 1 ♂ juv.
Brachyspiza capensis macconnelli.—VENEZUELA: summit of Roraima, 2 ♂, 2 ♀, 1 ♀ juv.

Brachyspiza capensis.—Adequate series of other races.

The fact that the slopes of Roraima are occupied by one race of *Brachyspiza capensis*, the summit by another and quite distinct one, evidently derived from it, is one of the most interesting and definite discoveries we have made in the origin of zonal races.

Both these races agree and differ markedly from all the other described races of this wide-ranging species in their darker colors, absence of brownish wash on rump, and sides, and, particularly, rounded wing.

¹See my paper on the distribution of this species in *The Auk*, 1925, pp. 193-208.

The larger size and darker colors of the Roraiman form living on the summit of the mountain significantly associates its differentiating characters with the higher altitude and greater humidity of its haunts. If, therefore, this be an instance of evolution by environment, it is of the utmost significance to observe that the differences between adults are shown also by nestlings and that consequently the racial characters are inherited.

The large amount of unworked material we have representing this species tempts further remarks concerning its geographic variations, but the subject must be postponed for the present.

"*Brachyspiza capensis*," doubtless the race here described, is recorded from the Merumé Mountains.

MEASUREMENTS

				Wing	Tail
<i>Brachyspiza capensis roraimæ</i>	Rondon Camp	♂		61	54
" " "	" "	♂		64	56
" " "	" "	♀		64	56
" " "	" "	♀		61.5	53.5
" " "	" "	♀		61	55
" " <i>macconnelli</i>	Summit of Roraima	♂		71	65
" " "	" " "	♂		71	65
" " "	" " "	♀		71	65
" " "	" " "	♀		67	61
" " <i>capensis</i>	Cayenne	?		65	51
" " "	Therezopolis, Brazil	?		71	61
" " "	São Paulo	♂		70	65
" " <i>peruviana</i>	Huaral, Peru	♂		73	58
" " "	" "	♂		74	65
" " "	" "	♂		69	58
" " "	" "	♀		70	59
" " "	Vitarte	♂		73	59

Cœreba guianensis roraimæ, new subspecies

SUBSPECIFIC CHARACTERS.—Similar to *Cœreba guianensis guianensis* (Cabanis) of the Tropical Zone of Guiana but larger and darker, the back black, the throat-patch larger and deeper gray; the general color as in *C. luteola* but with no evident white spot at the base of the primaries.

TYPE.—No. 237,272, Amer. Mus. Nat. Hist.; ♂ ad.; Arabupu, 4200 ft., Mt. Roraima, Venezuela; December 29, 1927; T. D. Carter.

SPECIMENS EXAMINED

Cœreba guianensis roraimæ.—VENEZUELA: Roraima; Paulo, 1 ♂; Arabupu, 4 ♂, 1 ♀.

Cœreba guianensis guianensis.—GUIANA: Rockstone, Essequibo River, 2 ♂, 3 ♀; Wismar, Demarara River, 1 ♂, 3 ♀. BRAZIL: Rio Cotinga, 1 ♂. VENEZUELA: Ciudad Bolivar, 1.

The larger size and darker colors of this race apparently express the influences of its environment. It is evidently a true mountain form, confined to the higher altitudes, since typical *guianensis* occurs both to the north and south of it.

MEASUREMENTS

					Wing	Tail	
<i>Careba guianensis roraimæ</i>			Arabupu, Roraima	♂	61	37	
"	"	"	"	"	♂	57	34
"	"	"	"	"	♂	62	38
"	"	"	"	"	♀	56	33
"	"	<i>guianensis</i>	Rockstone, B. C.	♂	54	31	
"	"		"	♂	53		
"	"	"	Wismar, "	♂	53	32	
"	"	"	Rockstone, "	♀	53	29	
"	"	"	"	"	♀	52	30

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In the hope that collections from the higher portions of the Duida group will throw some light on the problems presented by a study of the life of Roraima it has been considered advisable to defer a full report on the Roraima collections until those from Duida are received. Pending their arrival I present the following descriptions of new forms, including a remarkably distinct flycatcher, secured by the Day Expedition.

In the belief that Mt. Roraima constitutes the larger part if not entire range of the birds here described, I make no apology for frequent use of the name *roraimæ*.

The color terms employed are, as usual in the publications of the Department of Birds, from Ridgway.¹

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SUBSPECIFIC CHARACTERS.—Similar to *Columba albilinea albilinea* Bonaparte of the Subtropical and Temperate zones of the northern Andes but rump and upper tail-coverts much darker and strongly washed with the metallic olive-green of the back; the rectrices much darker, the black subterminal band much more pronounced and

¹Color Standards.

showing distinctly from above, the terminal band more slaty, deep mouse-gray, rather than mouse-gray; wing-quills and coverts darker, the underparts deeper, less glaucous.

TYPE.—No. 236,495, Amer. Mus. Nat. Hist.; ♂ ad.; Philipp Camp, alt. 6000 ft. Roraima, Venezuela; November 7, 1927; T. D. Carter.

SPECIMENS EXAMINED

Columba albilinea roraimæ.—VENEZUELA: Philipp Camp, 6000 ft., Roraima, 2 ♂ ad., 2 ♀ ad.; Rondon Camp, 6800 ft., Roraima, 1 ♂ im.

Columba albilinea albilinea.—COLOMBIA, 27. ECUADOR, 8.

This well-marked race is known only from the Subtropical Zone of Roraima. Here it is apparently widely separated from its species, the nearest point from which true *albilinea* has been recorded being the Cumbre of Valencia in northern Venezuela.¹ Thence it extends through the subtropics to Costa Rica and Bolivia.

Systellura ruficervix roraimæ, new subspecies

SUBSPECIFIC CHARACTERS.—Similar to *Systellura ruficervix ruficervix* (Selater) but larger and darker, the whitish markings fewer; the brownish markings of the rump, upper tail-coverts, wing-coverts and tertials reduced in area and darker, tawny rather than ochraceous-tawny; mottled grayish bars on the central rectrices narrower than intervening black areas; white marking on the four outer primaries not an unbroken bar, the white spots on the web of each feather either not reaching to the shaft or separated by the black, instead of white, shaft; bend of the wing and a small mark on the outer web of the longest alula ochraceous-buff or tawny instead of white. Two males measure: wing, 167, 168; tail, 111, 111 mm.; five males of *r. ruficervix* from Colombia measure: wing, 152, 153, 156, 159, 161; tail, 106, 103, 109, 111, 112 mm.

TYPE.—No. 236,552, Amer. Mus. Nat. Hist.; ♂ ad.; Philipp Camp, alt. 6000 ft., Mt. Roraima, Venezuela; November 11, 1927; T. D. Carter.

SPECIMENS EXAMINED

Systellura ruficervix roraimæ.—VENEZUELA: Roraima, Philipp Camp, alt. 6000 ft., 2 ♂.

Systellura ruficervix ruficervix.—VENEZUELA: Mérida region, 5 ♂, 3 ♀. COLOMBIA, 8 ♂, 5 ♀. ECUADOR, 3 ♂, 3 ♀.

The nearest point to Mt. Roraima from which *Systellura ruficervix* has been recorded is the Mérida region of Venezuela. Here it is found in the Temperate Zone and it occurs in this zone southward to Bolivia. The Roraiman form is, therefore, completely isolated from its nearest relative.

¹Hellmayr and Seilern, 1912, *Archiv für Naturg.*, LXXVIII, p. 159.

Trogonurus personatus roraimæ, new subspecies

SUBSPECIFIC CHARACTERS.—Similar to *Trogonurus personatus personatus* (Gould) of the Andean Subtropical Zone but central tail-feathers deep coppery-bronze instead of brassy-green; the crown, nape, back and breast more brassy, the white bars of the rectrices slightly wider, the black ones correspondingly narrower; size slightly smaller; 3 ♂; wing, 116, 120, 120 mm.; tail, 139, 140, 142 mm.

TYPE.—No. 236,600, Amer. Mus. Nat. Hist.; ♂ ad.; Rondon Camp, alt. 6800 ft., Mt. Roraima, Venezuela; December 2, 1927; T. D. Carter.

SPECIMENS EXAMINED

Trogonurus personatus roraimæ.—VENEZUELA: Mt. Roraima; above Paulo, between 5000 and 6000 ft., 1 ♂; Philipp Camp, 6000 ft., 1 ♂; Rondon Camp, 6800 ft., 1 ♂.

Trogonurus personatus personatus and *personatus assimilis*.—VENEZUELA: Mérida region, 2 ♂. COLOMBIA AND ECUADOR, 9 ♂, 9 ♀.

Eight of our nine males of *p. personatus* and *p. assimilis* show little variation in the general color of the upperparts and tail; the ninth, from El Eden in the central Andes of Colombia, is one of the brassy plumaged birds which seem almost to mark a color phase in trogons. It alone approaches *roraimæ* but the tail is brassy rather than bronzy.

The nearest point to Mt. Roraima from which *personatus* is known is the Mérida region of western Venezuela.

Elænia dayi, new species

SPECIFIC CHARACTERS.—The largest and darkest species of the genus; wings of about the same length as tail, proportionately shorter and more rounded than in typical *Elænia*.

TYPE.—No. 236,810, Amer. Mus. Nat. Hist.; ♀ ad.; summit of Mt. Roraima, 8600 ft., Venezuela; November 18, 1927; T. D. Carter.

DESCRIPTION OF TYPE.—Upperparts olivaceous chestnut drab, the crown chestnut black; upper tail-coverts chestnut drab, tail fuscous-black, the extreme tips of the feathers rusty; wings and their upper coverts fuscous-black; the inner quills margined externally with pale yellowish white, the lesser coverts broadly tipped on both webs, the greater covert on the outer web with soiled grayish white; bend of the wing yellowish; underparts citrine drab darker on the breast and sides, the chin paler, the center of the abdomen more yellow, under tail-coverts tinged with buffy brown; feet and bill black, the mandible brownish basally.

This remarkable new flycatcher is so unlike any recognized species that it is not possible to name with certainty its nearest relative. Geographically it is nearest *Elænia flavogaster flavogaster* of the slopes of Roraima; in color and in proportions it is nearest *Elænia obscura* of the Subtropical Zone of Peru and Bolivia. When compared with the species of *Elænia* that most closely approach it in size it will be observed that there is pronounced difference in the shape of the wing, the tail being

longer, the wing more rounded in *dayi*. These differences might be considered of generic value did they not largely disappear on comparison of *dayi* with *obscura*; and the fact that in color also *dayi* is nearest *obscura* suggests that, as in some other cases, the closest relative of the Roraiman bird is to be found in the Andes. But, whatever be its relationships, *dayi* agrees with *Brachyospiza capensis macconnelli*, also resident on the summit of Roraima, in being markedly larger and darker than any other species in its genus.

MEASUREMENTS

Name		Sex	Wing	Tail	Tarsus	Culmen	Longest Primary Longer Than Innermost
<i>Elænia dayi</i>	Summit of Roraima	♀	91	89	22	15	11
" <i>o. obscura</i>	Bolivia, 7700 ft.	♀	80	77	21	14	12
" "	" "	♂	82	77	20.5	14	13
" <i>gigas</i>	E. Ecuador	♀	93	77	20	14	17
" <i>f. flavogaster</i>	Rio Janeiro	♂	77	66	20	12	16
" " " "	" "	♂	80	67	20	13	15.5
" " " "	" "	♀	77	66	20	12	15.5
" " " "	Philipp Camp, Roraima	♂	85	76	20	15	14
" " " "	" " "	♀	79	72	20	14	14
" <i>spectabilis</i>	N. Argentina	♀	89	74	22	13.0	17
" <i>pelzelni</i>	L. Amazon	♂	89	73	21	15	16.5

In naming this species after Mr. Lee Garnet Day of New York City, I pay a well-deserved tribute to him, not alone for the support which made our Roraima expedition possible, but for the interest he has long shown in the American Museum.

***Compsothlypis pitiaiymi roraimæ*, new subspecies**

SUBSPECIFIC CHARACTERS.—Similar to *Compsothlypis pitiaiymi elegans* Todd, of northern South America, but with the dorsal patch smaller and darker, the white tail-spots smaller, the flanks tinged with olivaceous, the mandible basally horn, terminally black; tarsi black; the toes dark brown, their soles paler.

TYPE.—No. 237,071, Amer. Mus. Nat. Hist.; ♂ ad.; Arabupu, alt. 4200 ft., Roraima, Venezuela; January 7, 1928; T. D. Carter.

SPECIMENS EXAMINED

Compsothlypis pitiayumi roraimæ.—VENEZUELA: Roraima; Arabupu, 1 ♀; Paulo, 1 ♂.

Compsothlypis pitiayumi.—Other races; adequate series (see Amer. Mus. Novitates, 1924, No. 143, p. 2).

Compsothlypis pitiayumi is, generally speaking, a subtropical species which at the northern and southern limits of its range in subtropical latitudes, and locally elsewhere, occurs at sea-level.¹ In Guiana it is known only from Roraima, but *C. p. elegans* occurs in Trinidad, north-eastern Venezuela, central Venezuela and Colombia, whence other races carry the species south on the Andes to Argentina and north, chiefly in the mountains, to Texas.

One of our two Roraiman birds agrees with average specimens of *elegans* in the color of the underparts; the second specimen has the breast ochraceous-tawny. It is probably one of the highly colored individuals that sometimes occur in this species, but in our large series it cannot be matched, though it is approached by several specimens of *pacifica*.

***Brachyspiza capensis roraimæ*, new subspecies**

SUBSPECIFIC CHARACTERS.—Agrees with *Brachyspiza capensis macconnelli* Sharpe of the summit of Roraima and differs from other races of this species in having the wing short and rounded, the rump and flanks and sides gray, without brownish wash; differs from *B. c. macconnelli* in being smaller and having the black areas more restricted, the gray center of crown averaging as broad as the black lateral stripes instead of being nearly obscured by black.

TYPE.—No. 237,162, Amer. Mus. Nat. Hist.; ♂ ad.; Philipp Camp, 6000 ft., Roraima, Venezuela; November 9, 1927; T. D. Carter.

SPECIMENS EXAMINED

Brachyspiza capensis roraimæ.—VENEZUELA: Roraima; Paulo, 1 ♂, 2 ♂ juv., 1 ♀ juv.; Philipp Camp, 13 ♂, 8 ♀, 3 ♂ juv.; Rondon Camp, 5 ♂, 5 ♀, 1 ♂ juv.

Brachyspiza capensis macconnelli.—VENEZUELA: summit of Roraima, 2 ♂, 2 ♀, 1 ♀ juv.

Brachyspiza capensis.—Adequate series of other races.

The fact that the slopes of Roraima are occupied by one race of *Brachyspiza capensis*, the summit by another and quite distinct one, evidently derived from it, is one of the most interesting and definite discoveries we have made in the origin of zonal races.

Both these races agree and differ markedly from all the other described races of this wide-ranging species in their darker colors, absence of brownish wash on rump, and sides, and, particularly, rounded wing.

¹See my paper on the distribution of this species in *The Auk*, 1925, pp. 193-208.

The larger size and darker colors of the Roraiman form living on the summit of the mountain significantly associates its differentiating characters with the higher altitude and greater humidity of its haunts. If, therefore, this be an instance of evolution by environment, it is of the utmost significance to observe that the differences between adults are shown also by nestlings and that consequently the racial characters are inherited.

The large amount of unworked material we have representing this species tempts further remarks concerning its geographic variations, but the subject must be postponed for the present.

"*Brachyspiza capensis*," doubtless the race here described, is recorded from the Merumé Mountains.

MEASUREMENTS

				Wing	Tail
<i>Brachyspiza capensis roraimæ</i>	Rondon Camp	♂		61	54
" " "	" "	♂		64	56
" " "	" "	♀		64	56
" " "	" "	♀		61.5	53.5
" " "	" "	♀		61	55
" " <i>macconnelli</i>	Summit of Roraima	♂		71	65
" " "	" " "	♂		71	65
" " "	" " "	♀		71	65
" " "	" " "	♀		67	61
" " <i>capensis</i>	Cayenne	?		65	51
" " "	Therezopolis, Brazil	?		71	61
" " "	São Paulo	♂		70	65
" " <i>peruviana</i>	Huaral, Peru	♂		73	58
" " "	" "	♂		74	65
" " "	" "	♂		69	58
" " "	" "	♀		70	59
" " "	Vitarte	♂		73	59

Cœreba guianensis roraimæ, new subspecies

SUBSPECIFIC CHARACTERS.—Similar to *Cœreba guianensis guianensis* (Cabanis) of the Tropical Zone of Guiana but larger and darker, the back black, the throat-patch larger and deeper gray; the general color as in *C. luteola* but with no evident white spot at the base of the primaries.

TYPE.—No. 237,272, Amer. Mus. Nat. Hist.; ♂ ad.; Arabupu, 4200 ft., Mt. Roraima, Venezuela; December 29, 1927; T. D. Carter.

SPECIMENS EXAMINED

Cœreba guianensis roraimæ.—VENEZUELA: Roraima; Paulo, 1 ♂; Arabupu, 4 ♂, 1 ♀.

Cœreba guianensis guianensis.—GUIANA: Rockstone, Essequibo River, 2 ♂, 3 ♀; Wismar, Demarara River, 1 ♂, 3 ♀. BRAZIL: Rio Cotinga, 1 ♂. VENEZUELA: Ciudad Bolivar, 1.

The larger size and darker colors of this race apparently express the influences of its environment. It is evidently a true mountain form, confined to the higher altitudes, since typical *guianensis* occurs both to the north and south of it.

MEASUREMENTS

				Wing	Tail
<i>Careba guianensis roraima</i>			Arabupu, Roraima	♂	61 37
"	"	"	"	♂	57 34
"	"	"	"	♂	62 38
"	"	"	"	♀	56 33
"	"	<i>guianensis</i>	Rockstone, B. C.	♂	54 31
"	"	"	"	♂	53
"	"	"	Wismar, "	♂	53 32
"	"	"	Rockstone, "	♀	53 29
"	"	"	"	♀	52 30

59.7, 55C: 14.71, 5

CRANIAL DIFFERENCES IN THE AFRICAN CHARACIN
FISHES OF THE GENERA *ALESTES* AND *BRYCINUS*,
WITH NOTES ON THE ARRANGEMENT OF
RELATED GENERA¹BY GEORGE S. MYERS²

While engaged in a comparison of the skeletons of certain American and African tetragonopterid characins I had occasion to examine the crania of two species referred by Boulenger to *Alestes*, namely, *A. liebrechtsii* Boulenger and *A. grandisquamis* Boulenger. These skulls, both from specimens collected by Messrs. Herbert Lang and J. P. Chapin of the American Museum Congo Expedition, at Faradje, Belgian Congo, appeared so different as to suggest that the species should be generically separated. Starks (1926, p. 167, footnote), after a study of these same two specimens, has suggested that generic differences exist between them. The skeletons are now in the collection of Stanford University, and I wish to thank Prof. E. C. Starks for the privilege of examining them. Dr. E. W. Gudger of the American Museum has been kind enough to send me some other African characins for skeletonization and comparison.

The cranium of *Alestes liebrechtsii* (Fig. 1) is of a tapering type, much wider posteriorly than anteriorly, and the roof is greatly arched in transverse section. The thin, somewhat translucent frontals are slightly fluted, this fluting radiating from a common center near the outer posterior part of each bone. Extending from the supraoccipital far between the frontals is an oval fontanel, entirely separating the parietals. The tube of orbitosphenoid bone which protects the olfactory nerve as it leaves the brain-case to meet the prefrontal is met by a similar tube extending out from the latter bone.

In *Alestes grandisquamis*, on the contrary, the cranium (Fig. 2) is short and heavy, and narrows anteriorly practically none at all. The roof is flattened and little convex, the bones thick, massive, and opaque.

¹Scientific Results of the American Museum Congo Expedition. Ichthyology, No. 7.²Of Stanford University, California.

There is no fluting but instead radial striations of the bone. There is no suggestion whatever of a fontanel, the parietals meeting each other suturally. The orbitosphenoid olfactory nerve-tube extends to the prefrontal, where it meets only a slight rim about the nerve foramen. Furthermore, the facial bones forming the circumorbital chain are thick and deeply striated, very different indeed from the thin bones of the other species. The teeth are decidedly more massive than in *liebrechtsii*.

These differences appear to me to be of generic value, but it remains to be seen whether or not they extend with the same distinctness through-



Fig. 1. *Alestes liebrechtsii* Boulenger. Cranium from above.

1. Mesethmoid. 2. Frontals. 3. Parietals. 4. Supraoccipital.

out any two groups of the species that are currently referred to *Alestes*. I have prepared and examined the skeleton of a small specimen of *A. imberi* Peters and find that it agrees substantially with the characters given above for *A. grandisquamis*. In this specimen the olfactory nerve-tube is not distinctly separated distally from the orbitosphenoid wall, and it does not reach the prefrontal, but as in *grandisquamis* there is no prefrontal tube, not even a rim being seen about the prefrontal foramen.

These three skeletons are, unfortunately, the only ones of *Alestes* available to me. Sagemehl (1885, Taf. 2, figs. 17 and 18) has, however,

figured the cranium of *Alestes dentex* and it is easily seen that, in so far as the tapering form and fontanel go, it conforms admirably to my description of *liebrechtsii*. Further, Regan (1911, p. 18) remarks, ". . . most species of *Alestes* have fontanels, but in *Alestes macrolepidotus* they are absent and the parietals are united by suture." This apparently agrees with the structure of *imberi* and *grandisquamis*.

Both of the species which we have seen to possess a tapering skull and a parietal fontanel have certain external features in common. *A. dentex* and *A. liebrechtsii* are elongate, herring-like fishes with compara-



Fig. 2. *Brycinus grandisquamis* (Boulenger). Cranium from above.
Numbers as in Fig. 1.

tively small scales and a well-developed adipose eyelid. The three lacking the fontanel, *A. grandisquamis*, *A. macrolepidotus*, and *A. imberi*, are differently shaped fishes with large, heavy, oblique scales and the adipose eyelid very slightly developed or absent.

It appears to me that we are dealing with two distinct genera. To one of them, typified by *A. liebrechtsii* and *A. dentex*, we may leave the name *Alestes* Müller and Troschel, of which the genotype is *niloticus* Geoffroy = *dentex* Linné.¹ To the other we may apply *Brycinus*

¹I use *dentex* in the Boulengerian sense. It is possible that *dentex* will not stand for this species.

Cuvier and Valenciennes, of which the genotype is *macrolepidotus* Cuvier and Valenciennes. What will be the distribution of many of the species not examined, which are currently referred to *Alestes*, cannot be settled without osteological investigation of them. It is hoped that some one with more material at his command will carry the work through.

NOTES ON RELATED GENERA

The *Tetragonopterus*-like characin fishes of Africa appear to differ externally from their American relatives in the closely bound-down maxillary and in having the lateral line extending out through the lower part of the caudal peduncle rather than through the middle. Boulenger's arrangement, in four genera (*Bryconæthiops*, *Alestes*, *Micralesles*, and *Petersius*), can probably be emended to advantage, as has been indicated above. Merely to express my idea of the relationships of *Alestes*, *Brycinus*, and the other genera, I have prepared a synopsis of the genera. This is not intended to be taken as an analysis of the generic groups, but only as a basis for discussion of the characters involved.

SYNOPSIS

- a. Premaxillary teeth in three series, the inner tuberculate or molariform, with excavated crowns; dorsal fin originating in advance of pelvic fins; cranium flat and rather broad; a parietal fontanel present.
 - Bryconæthiops* Günther.
- aa. Premaxillary teeth in two series; dorsal originating above or behind pelvic fins.
 - b. Inner series of premaxillary teeth with obliquely truncated or molariform excavated crowns.
 - c. Cranium flattened, not tapering; no fontanel; dentition massive; scales large and thick; adipose eyelid feeble or absent. *Brycinus* Cuvier and Valenciennes.
 - cc. Cranium arched and tapering forward; fontanel present; dentition moderate; scales fine; a well-developed adipose eyelid. *Alestes* Müller and Troschel.
- bb. Both series of premaxillary teeth simply compressed.
 - d. Scales of the lateral line and rows below abruptly smaller than those of the rows above.
 - Arnoldichthys* Myers.
 - dd. Scales of the lateral line and rows below of approximately the same size as those above.
 - e. Parietal fontanel absent.
 - Petersius* Hilgendorf.
 - ee. Parietal fontanel present.
 - Micralesles* Boulenger.

BRYCONÆTHIOPS Günther

This genus is well distinguished by the triple series of premaxillary

teeth and the dorsal position. There is a fontanel and a wide adipose eyelid. I have examined one *B. macrops* Boulenger, 150 mm. total length.

There appear to be two or three species in the Congo. Nichols and Griscom (1917, p. 678) doubt the distinctness of *B. yseurii* Boulenger from *B. microstoma* Günther, but they appear to have had some examples of the subsequently described *B. macrops*.

BRYCINUS Cuvier and Valenciennes

This genus has a great superficial resemblance to the American *Chalceus*, as Cockerell (1914, p. 107) has noted. Besides *B. macrolepidotus*, *B. imberi*, and *B. grandisquamis*, the following seem referable to this genus on external characters: *Brycinus nurse* (Rüppell), *B. schoutedeni* (Boulenger), *B. brevis* (Boulenger), *B. batesii* (Boulenger), *B. rhodopleura* (Boulenger), *B. bimaculatus* (Boulenger), *B. kingsleyæ* (Günther), *B. utilis* (Boulenger), *B. affinis* (Günther), *B. jacksonii* (Boulenger), *B. carmesinus* (Nichols and Griscom), *B. lateralis* (Boulenger), *B. curtus* (Boulenger), and *B. vittatus* (Boulenger).

There may be an unsuspected generic type in the other species of the Boulengerian "*Alestes*" which do not resemble either *Brycinus* or *Alestes*. Five very similar species, *Alestes tholloni* Pellegrin, *A. intermedius* Boulenger, *A. tessmanni* Pappenheim, *A. longipinnis* (Günther), and *A. chaperi* Sauvage, form one group. Again, apparently of another group are: *Alestes poptæ* Pellegrin, *A. opisthotænia* Boulenger, *A. tenuis* Boulenger, *A. humilis* Boulenger, *A. stolatus* Boulenger, *A. sadleri* Boulenger, and *A. stuhlmanni* Pfeffer.

ALESTES Müller and Troschel

Referable to this group seem to be but five species: *Alestes dentex* (Linné), *A. baremose* (Joannis), *A. macrophthalmus* Günther, *A. liebrechtsii* Boulenger, and *A. ansorgii* Boulenger.

ARNOLDICHTHYS Myers

The writer erected this genus in 1926 for a single peculiar species from the Niger, *Arnoldichthys spilopterus* (Boulenger). The scales are unlike those of any other characin.

PETERSIUS Hilgendorf

Boulenger included a number of small species with fontanels in this genus, but it must be restricted to a single species only, *P. conserialis* Hilgendorf, a peculiar large form from East Africa, lacking a fontanel.

MICRALESTES Boulenger

Boulenger separated *Micralestes* from *Petersius* on the presence in the former of a pair of conical teeth behind the mandibular series. I have indicated above that *Petersius* must be restricted to its single original species. Nichols and Griscom (1917, p. 682) were unable to find these conical teeth in *M. altus* and it seems likely that the distinction is not a valid one. At least a classification which separates *Petersius pulcher* Boulenger and *P. major* Boulenger from such a similar fish as *Micralestes wrotænia* Boulenger should be very carefully scrutinized before it is accepted. For the present I prefer to place all the species assigned to *Petersius*, save *conserialis*, in *Micralestes*. That this is a tentative arrangement should not be lost sight of, for I have been able to examine only *M. acutidens*.

Micralestes as thus constituted is arbitrarily separable into two groups. The species with the lateral line incomplete¹ fall into the subgenus *Phenacogrammus* Eigenmann² (1907, p. 30). *Hemigrammalestes* Pellegrin³ (1925, p. 158) is an exact synonym of Eigenmann's name, and if the character of the teeth is not valid, then *Hemigrammopetersius* Pellegrin⁴ (1925, p. 158) is also a synonym. The other group, with lateral line complete, is of course, *Micralestes*, *sensu stricto*. Within this group we may indicate that *M. hilgendorfi* Boulenger and *M. leopoldianus* Boulenger are very closely related.

If the character of the conical teeth is found to be valid the species included here under *Micralestes* which were placed by Boulenger in *Petersius* must be known under the generic term *Hemigrammopetersius* Pellegrin.

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¹An inconsistency may be seen in the failure to consider an incomplete lateral line of generic value in these fishes, while it is retained as a diagnostic character of a number of genera of American characins. In the present instance it seems clear that the loss of part of the lateral line in a few species is a mark of individual specialization and not significant of genetic relationship between the line-less species. This is doubtless the case with several of the American genera, but until the needed careful realignment of the entire mass of neotropical characins has been carried through, it would cause needless confusion to peremptorily synonymize certain genera on the inadequate premises now available.

²Genotype *M. interruptus* Boulenger.

³Of which the genotype is hereby fixed as *M. interruptus* Boulenger.

⁴Of which the genotype is hereby fixed as *Petersius major* Boulenger.

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BEES, CHIEFLY AUSTRALIAN SPECIES, DESCRIBED OR
DETERMINED BY DR. H. FRIESE

BY T. D. A. COCKERELL

Some years ago, the American Museum obtained from Dr. Friese a series of Australian bees, many of them representing species he had described, and labeled "Typus." As I am preparing a work on the bees of Australia, it seems desirable to review these specimens, and state the results when these are of any special significance. Mr. Herbert F. Schwarz, transmitting the collection, has kindly added a number of *Megachile* in his possession, which, he states, will be placed in the American Museum. A few specimens from New Guinea have also been sent.

***Hylæoides concinnus* var. *collaris* Friese**

This is not a subspecies, but a variety with a pair of widely separated red marks on the prothorax above.

***Paracolletes semipurpureus* (Cockerell) and var. *frenchi*, new variety**

NEW SYNONYM.—*Lamprocolletes cupreus* var. *minor* Friese. This differs from *P. semipurpureus* var. *b.* Cockerell (Rutherglen, Victoria; French) by the dull, much less shining, abdomen, the area of metathorax yellowish green, hind basitarsi broader basally, and mandibles all dark.

The var. *b.* may be called var. *frenchi*, new variety.

***Paracolletes crassipes* Smith**

NEW SYNONYM.—*Paracolletes australis* Friese. Adelaide, Sydney, and Melbourne.

***Paracolletes thornleighensis* Cockerell**

NEW SYNONYM.—*Lamprocolletes nigriventris* Friese. The type locality (Thornleigh, New South Wales) is the same for both names. Friese described only the ♂, but I find a ♀ (Sydney, Sept. 14, 1906) correctly determined by him as conspecific. It is distinctly larger than one in my collection. Working over this species, I was astonished to find (equally in my specimen and that from Friese) that the eyes are sparsely hairy. Yet there is no affinity with the genus *Trichocolletes*, as shown by the stigma and other characters.

***Paracolletes friesei* Cockerell**

This was recently described from a specimen in the Queensland Museum, from King George's Sound, W. Australia. It is easily recognized by the very dense bright-ferruginous hair on thorax above, the white hair of sides of face and cheeks, and the shining blue-green abdomen. *P. fervidus* Friese (not Smith) is the same species; the specimen in the American Museum has the abdomen darker than in my type.

***Paracolletes maorium* Cockerell**

A female of this species, labeled "N. Holl., Riedtm.,"¹ carries a name proposed by Friese, but apparently not published, indicating a blue abdomen, though as a matter of fact the abdomen is green. My type was labeled New Zealand, but there is perhaps some doubt as to the true habitat of the species.

***Paracolletes providellus cærulescens*, new variety**

This male was labeled *Lamprocolletes cærulescens* Friese, but the name seems not to have been published. It comes from Como, N.S.W., Nov. 1, 1902 (W. W. Froggatt). It is a variety of *P. providellus* Cockerell, closely related to *P. providellus bacchalis* Cockerell, from the type of which it differs as follows: the legs all rather dark red, including femora; abdomen shining steel-blue with hind margins of segments conspicuously dusky reddish. If *bacchalis* be considered a separate species, this is a variety of *bacchalis*. A female labeled *L. cærulescens*, with dark stigma and hind margins of segments not reddish, is *P. versicolor* Smith. It is a singular thing that the hind basitarsi, seen from in front, show bright-ferruginous hair, but seen from behind, clear white. This female is from Lebra, N.S.W. (W. W. Froggatt).

***Paracolletes perminutus*, new species**

♀.—Length about 7 mm.; black, with the mandibles chestnut-red, except basally, flagellum dusky ferruginous beneath except at base. Hairs of head and thorax white, scanty and short, very short dorsally, occiput with rather long clear white hair; clypeus dull and excessively densely punctured, with a smooth median line, not extending to lower margin; face broad, facial quadrangle about square; vertex closely punctured. Mesothorax shining, with very distinct punctures, which are rather widely separated on disc; scutellum with large punctures and a median sulcus; base of metathorax not polished, but with a sharp transverse keel, above which the area exhibits about five well-spaced plicæ on each side; tegulæ dark rufous. Wings quite clear, stigma very pale dull yellowish, with a dark border, nervures fuscous; basal

¹This collector was also in New Zealand; see *Hylæus fijiensis*.

nervure meeting nervulus; second cubital cell narrow, receiving recurrent nervure a little beyond middle; third cubital cell broader above than second. Legs dark brown, with white hair, scopa of hind legs white; hair on inner side of hind basitarsi dark, not brightly colored. Abdomen broad, shining, thinly white-pruinose, without bands or spots; hind margins of second and following segments obscurely reddish; apical tuft black; venter without long hair.

Freemantle, W. Australia, Aug. 20, 1906 (Frank).

This is *Lamprocolletes minutus* Friese, but I had earlier given that specific name to a related species. The first abdominal segment is smooth and highly polished, this feature and the color of the stigma indicating that this cannot be the female of *L. minutus* Cockerell. It is very probable, as Meade-Waldo suggested years ago, that *L. halictiformis* Cockerell is the female of *L. minutus* Cockerell. The species now described is very like *L. halictiformis*, agreeing in respect to the red mandibles, but differing in that the clypeus is shorter and more densely punctured, the face narrower, lateral ocelli much nearer eyes, mesothorax less densely punctured, abdomen without white hair-bands, and wings clear hyaline, not grayish. The polished base of abdomen is also highly distinctive. This is not *P. nanus* Smith, by the character of area of metathorax, and apical margins of abdominal segments not being pale testaceous.

***Paracolletes ventralis* (Friese)**

Dasycolletes ventralis Friese, Sydney, N.S.W., Sept. 14, 1906 (Frank).

A striking and distinct species, which Friese describes in two and a half lines.

♀.—Length about 12.5 mm.; rather narrow; black, without metallic colors; tegulae rufescent. Wings dilute reddish fuliginous, stigma and nervures dusky yellowish ferruginous. Hair of head and thorax mostly short and very scanty, black. Abdomen above practically nude, no long hair on first tergite, no bands, hair at apex black, but ventral segments with large and dense cream-colored fringes, and extreme sides with some glittering pale-golden hair, situated on margins of tergites. Mandibles with hardly visible reddish color apically; facial quadrangle broader than long; clypeus with dense coarse punctures, and no smooth line; supraclypeal area with an elevated polished median ridge; antennae short, flagellum obscurely reddish; vertex very coarsely punctured; cheeks small. Mesothorax with extremely large punctures, irregular and widely separated on disc, the surface between them shining; median sulcus very deep; mesopleura shining, with sparse punctures; area of metathorax large, triangular, convex, highly polished, without sculpture or transverse keel. Basal nervure meeting nervulus; second cubital cell strongly contracted above, receiving recurrent nervure much beyond middle; marginal cell obliquely truncate at end; stigma well developed; third cubital cell extremely broad above. Legs with mainly black hair, but the extremely long hair of inner side of hind tibiae pale fulvous; hair on inner side of hind basitarsi pallid; tarsi with small joints red. First two abdominal segments highly polished, hardly punctured; the others dull, with very minute punctures, except the broad shining hind margin.

There is some resemblance to *P. obscurus* Smith, as judged by the description, but I have *P. obscurus*, and it is not closely allied.

***Paracolletes punctiventris*, new species**

The collection contains a specimen labeled *Lamprocolletes punctiventris* Friese, ♂, Sydney, N.S.W., Sept. 14, 1906. Apparently the description has not been published.

♂.—Length about 8.5 mm.; head and thorax shining black, with the clypeus very dark reddish; legs and abdomen dark brownish; hair of head and thorax long, quite abundant, dull white, tinged with brown on vertex, thin on face, not at all hiding surface of clypeus. Head broad, eyes converging below; mandibles bidentate, very obscurely reddish apically; clypeus with the disc very broadly flattened, polished, sparsely punctured, with a low median ridge; antennae submoniliform, the flagellum obscurely reddish beneath; a shining space in front of ocelli. Mesothorax shining, the disc posteriorly almost impunctate; scutellum shining, irregularly punctured; area of metathorax triangular, convex, highly polished, not sculptured, but very obtusely transversely ridged; mesopleura shining; tegulae clear rufo-testaceous. Wings clear, faintly brownish, stigma (which is large) and nervures ferruginous; basal nervure meeting nervulus; second cubital cell receiving recurrent nervure in middle; marginal cell narrowly produced apically; third cubital very broad above. Legs with white hair. Abdomen shining, very distinctly punctured, first segment with thin white hair, second to fourth at sides with weakly developed white hair-bands, not conspicuous; fifth sternite with a stiff fringe of long pale hair, especially long at sides.

This is extremely close to *P. incanescens* Cockerell, agreeing in the general structure, the clypeus, area of metathorax, venation, etc. I thought it might be a local race, but the ventral fringe on abdomen, with the differences in color, indicate a closely allied but separable form. The area of metathorax is not transversely striate, as it is in *P. speculiferus* Cockerell and *P. perpolitus* Cockerell. Friese omitted it when publishing his Australian bees in 1924, I suppose doubting its validity. It was probably collected by Frank.

***Paracolletes rufoæneus* (Friese)**

Dasycolletes rufoæneus Friese, ♂, Adelaide, Sept. 21, 1906 (Frank). This is extremely like *P. bimaculatus* (Smith), with the same hairy wings, small second and very large third cubital cells, and dusky spots at sides of second abdominal segment. It differs from the type of *P. bimaculatus* in the venation; the second cubital cell receives the recurrent nervure not far from its end, the basal nervure falls a little short of nervulus, and the second recurrent nervure meets the outer intercubitus. The following particulars may be added to the original description.

Pure white hairs of cheeks very long, contrasting with the yellow of face and vertex; labial palpi with first joint dark, the others pale yellowish, sharply contrasting; clypeus dull in middle, but shining around the sides, with evident punctures; supraclypeal area shining; front and vertex dull, as also mesothorax and scutellum, except that the latter is shining anteriorly; a shining spot beneath wings; area of metathorax dull, with a pronounced transverse ridge; flagellum very long, black; tegulae small, dark reddish. Wings brownish hyaline; stigma large, dull ferruginous, nervures fuscous; second cubital cell triangular, coming almost to a point above. Knees, tibiae, and tarsi dusky rufous, the anterior and middle tibiae with a large black spot behind. First abdominal segment dark, with a brassy tint, its hind margin red; extreme apex of abdomen dusky.

***Paracolletes franki*, new species**

♀.—Length a little over 12 mm.; black, robust, shining, flagellum red beneath except at base, legs obscure reddish. Head large, facial quadrangle broader than long; mandibles black, long, curved, falciform, the inner tooth far from the apex; malar space short but evident; labrum prominent, with a large tuft of reddish hair projecting below; clypeus convex, highly polished, without sculpture; front dullish, sides of vertex shining; face and cheeks with white hair, on face tinged with yellow, and yellowish hair on occiput, but front and vertex with black hair. Mesothorax polished, with scarcely evident scattered weak small punctures, median sulcus strong; scutellum highly polished; area of metathorax with a transverse keel, above which the surface is shining, without sculpture; hair of mesothorax and scutellum short and black, of thorax in front very pale yellowish, becoming fulvous on tubercles; pleura with dull white and metathorax with long fulvous-tinted hair, the latter covering the sides, not forming a definite fringe; tegulae black, very faintly reddish posteriorly. Wings long and ample, brownish hyaline, stigma (well developed) and nervures dusky reddish; basal nervure meeting nervulus; second cubital cell broad but narrowing above, receiving recurrent nervure in middle; third cubital very large, receiving second recurrent some distance from end. Legs with mostly white hair, tinged with reddish on inner side of tarsi, the ample scopa of hind tibiae shining white in front, and dark fuscous posteriorly, hind basitarsi with hair very bright ferruginous seen from in front, but posteriorly shining reddish-white. Abdomen broad, shining, hardly punctured, hind margins of segments broadly, very obscurely reddish; first segment with loose pale hair, the others (especially at sides) with thin pruinose pale pubescence, but no bands; apex with black hair; venter with much pure white hair.

Adelaide, Australia, Sept. 21, 1906 (Frank).

Friese identified this doubtfully with *P. cinereus* (Smith), which is, however, quite different, with coarsely punctured clypeus. There is some resemblance to *P. argentifrons* (Smith), but it is not close. It is also a little like *P. fervidus subdolos* Cockerell.

Paracolletes fulvescens (Smith)

♀.—Waikana Bay, New Zealand (Schauinsland). Determined by Friese as *P. hirtipes* (Smith). When I examined Smith's types, I thought *hirtipes* and *fulvescens* were forms of one species, but more material is desirable. As noted by Smith, the ocelli of *P. fulvescens* are in a slight curve instead of in a triangle as in *P. crassipes* Smith, the type of *Paracolletes*.

Paracolletes mimulus Cockerell

♀.—Adelaide, Sept. 21 (Frank). Sent as "*P. cupreus* Smith?"

Paracolletes melbournensis Cockerell

♀.—Alexandra, Victoria, 1903. Sent as "*P. cupreus* Smith?" Two males, also marked "*P. cupreus* Smith?", come from Ararat, Victoria. The male is very like *P. plumosus* Smith, but the hair of head and thorax is strongly fulvous-tinted, black on vertex and disc of thorax; face (including clypeus) green; abdomen green; antennæ entirely dark; tegulæ rufotestaceous. For an account of the real *P. cupreus*, based on Smith's type, see Trans. Amer. Ent. Soc., XXXI, p. 345.

Paracolletes festivus, new species

♂.—Size and general appearance of *P. plumosus* Smith; anterior wing 8 mm. Head broad; clypeus convex, with large but only moderately dense punctures, steel-blue, with the lower part black; mandibles black, very faintly reddish apically; rest of head greenish blue; flagellum ferruginous beneath. Hair of head and thorax white, on vertex and dorsum of thorax stained with reddish. Mesothorax and scutellum steel-blue, with large and not very dense punctures; surface between the punctures shining; mesopleura dull and dark blue; metathorax very dark blue, the basal area dull in some lights, more shining in others, the basal part, above the transverse keel, minutely transversely lineolate, the part below the keel microscopically vertically lineolate, the sculpture very dense; tegulæ rufofulvous. Wings clear hyaline, stigma and nervures ferruginous; basal nervure meeting nervulus; second cubital cell not very broad, receiving recurrent nervure in middle; third cubital broader above than second. Legs chestnut-red, the tibiæ and tarsi lighter than the femora; hair of legs white; the anterior femora are quite dark, strongly contrasting with the pallid anterior face of their tibiæ. Abdomen shining, splendid purple-blue, the basal declivity of first segments, and the margins of the other segments, dark red, but on segments 3 to 5 the extreme edges are pallid; venter dark red.

Sydney, N.S.W., Sept. 14, 1906, evidently collected by Frank.

It is labeled "*Lamprocolletes plumosus* Smith?", but is easily distinguished from this and the smaller *P. plumosellus* Cockerell by the color of antennæ, legs, and abdomen. It is, however, closely allied.

Lithurgus scabrosus (Smith)

♀.—Finshafen (Finschhafen?), New Guinea, 1901 (H. Kühn). Labeled *L. atratus* Smith.

Megachile nidulator Smith

♀.—Finshafen (Finschhafen?), New Guinea. Sent without name.

Megachile australasiæ Dalla Torre

Friese evidently confused two or more species under this name. A female from Mackay, Queensland (Turner) is *M. macularis* Dalla Torre. The genuine *M. australasiæ* was noted at British Museum to have broad fulvous hair-bands on abdomen. Smith describes the ventral scopa as white, but it is black on last segment.

Megachile quinquelineata Cockerell

NEW SYNONYM.—*M. glaberrima* Friese. Specimen from Cairns, Queensland.

Megachile minutula Friese

♀.—Finschhafen, New Guinea (Hertle). This is almost exactly the same as *M. quinquelineata*, differing by the clear orange hair on inner side of hind basitarsi. The character of the black hair at sides of abdomen, cited by Friese, also exists in *M. quinquelineata*.

Megachile nigrohirta (Friese)

♀.—Finschhafen, New Guinea. This was described (1909) as a variety of *M. placida*, but I consider it a distinct species. *M. biroi* Friese is in the collection from the same locality, collected by Hertle.

Megachile ustulatiformis Cockerell

♂.—Kuranda, Queensland. Carries an apparently unpublished name by Friese, referring to the ample tarsi. This has every appearance of being the male of *M. nigrohirta*, but as one occurs in Australia, the other in New Guinea, it is not safe to associate them. *M. ustulatiformis* was described in 1910.

Megachile nasuta argentifer Cockerell

Ararat, Victoria. Carries an apparently unpublished name by Friese, referring to the resemblance to a *Lithurgus*.

Megachile latipes Smith

♂.—Sydney, N.S.W., Sept. 14, (Frank). Carries an apparently unpublished name by Friese, referring to the white pilosity.

Megachile sericeicauda Cockerell

This was obtained at Mackay, and named in manuscript by Friese after Turner.

Megachile chyeri Friese

♀.—Finschhafen, New Guinea (Hertle). This greatly resembles *M. chrysopyga* Smith, but the narrow abdominal hair-bands are fulvous, and the last tergite is not covered with red hair. The lower half of the supra-clypeal area is bare and polished. The front and sides of face have rich orange hair, the vertex has black hair. The clypeus has a shining transverse depression above the margin.

Megachile erimæ Mocsary

♀.—Stephansort, Astrolabe Bay, New Guinea (Biro). This modest-looking species is best known by the apical tergite rapidly descending, with strongly concave lateral profile. The legs are dark reddish, the hind femora and tibiæ posteriorly black. I do not find any closely related Australian species.

Mesotrichia bryorum aruana (Ritsema)

♀, ♂.—Finschhafen, New Guinea (Hertle). Friese calls this *Xylocopa bryorum* Fabricius, giving *X. aruana* Ritsema as a synonym. The structure and color (including that of wings) agree with *bryorum*, but the specimens are large. Ritsema gave 23 mm. as the length of the female. The male has the clypeus black, with a median band, narrow apical margin, and broad lateral corners yellow. I think there is some basis for the recognition of a subspecies, for which Ritsema's name is apparently available. Additional material is desirable. I have seen a form, from New Guinea, in which the wings were suffused with rosy-purplish.

Callomelitta littleri Cockerell

NEW SYNONYM.—*C. nigriventris* Friese, ♀, Adelaide, Sept. 21, 1906. Above the printed label with this information is an apparently older written one, "Austral." Specimens of *Paracollates* in the collection, bearing Froggatt's labels Como and Levra respectively, also have, under these labels, printed labels, "Sydney, 14.9.06." Thus a certain amount

of doubt is thrown on the locality labels of Frank's specimens. If any were given to him without labels, would not the erroneous labels have been attached, perhaps after they left Frank's hands?

Callomelitta picta perpicta Cockerell

NEW SYNONYM.—*C. cyanescens* Friese, ♂. Central Australia (von Müller, 1893). I described this as a distinct subspecies, because it differed conspicuously from Smith's type male. But I now feel nearly certain that this is the true male of *C. picta*, the type of which must be considered the female described by Smith. I think Smith's male was the male of *C. littleri*, described by me as *C. nigrofasciata*.

Callomelitta picta chlorura, new subspecies

♀.—Abdomen green instead of blue, the general effect dark. Middle and hind femora chestnut-red (much darker in *C. picta* Smith). With labels "Austral." and "Adelaide, 21.9.06 (Frank)." Friese had labeled it *C. picta*.

Nomia victoriæ Cockerell

NEW SYNONYM.—*Nomia fulvoanalis* Friese, ♀, Ararat, Victoria. Both names are based on specimens from Ararat. The specimen of *N. fulvoanalis* before me differs from my type in having the mesothorax more shining, less evidently punctured, and the broad hair-band on the fourth abdominal segment colored like that on the third, instead of being strongly orange. Apparently these characters vary, for Friese describes *N. fulvoanalis* as having the band on fourth segment yellow-brown and indicates that the mesothorax is like that of *N. analis*.

Nomia analis Friese

♀.—Mackay, Queensland, at flowers of *Cassia* (Turner). Six specimens from Mackay have long stood in my collection as *N. victoriæ* var. They differ in lacking the broad hair-bands on abdominal segments 3 and 4, segments 1 to 4 having only short lateral stripes of pure white hair. In nearly all respects they are exactly like *N. victoriæ*, but, after again reviewing the matter, I believe *N. analis* may stand.

Nomia halictella Cockerell

A Mackay specimen is erroneously labeled *N. nana* Smith. I have the true *N. nana* from Victoria.

Nomia semiaurea Cockerell

A female and male from Cairns are labeled *N. cincta* var. *tomentifera* Friese. The female is genuine *H. tomentifera*, which I consider a distinct species, but the male is *N. semiaurea* Cockerell. This male is easily separated from *N. tomentifera*, male, by the very short black scape, the black mesothorax (without the broad lateral bands and central streak of fulvous tomentum), the narrower abdomen, and the ordinary (obtusely bigibbous) scutellum.

Nomia flavoviridis Cockerell

NEW SYNONYM.—*Nomia ænescens* Friese, ♀, Mackay, Queensland (Turner). This applies to the Queensland insect, ascribed to *N. ænescens* by Friese. I have not seen *N. ænescens* from New Guinea, whence it was first described.

Nomia tenuihirta Cockerell

NEW SYNONYM.—*Nomia latitarsis* Friese. ♀. The specimen is from Mackay, on *Cassia* (Turner).

Nomia testaceipes (Friese)

♂.—*N. argentifrons testaceipes* Friese, Central Australia, 1893 (von Müller). The name used on the label designates the insect as having red legs; Friese doubtless changed it in publication (though to a less appropriate one) because he had already described a *N. rubripes* from Africa. This is one of the numerous *N. flavoviridis* forms, distinguished by the black head, mesothorax, and scutellum (though dark green pleura); lower half of clypeus white; flagellum bright ferruginous beneath but dusky above; tegulæ clear bright apricot color; stigma and nervures fuscous; first recurrent nervure reaching base of third cubital cell; legs red with the femora more or less dark; abdomen dark-olive green, but lighter and brighter on first segment; abdominal hair-bands dull white; third and fourth abdominal sternites each with a pair of light ferruginous protuberances.

I cannot identify this exactly with any of the four named races of *N. flavoviridis*, but it probably should be regarded as a subspecies of that species.

Nomia brisbanensis Cockerell

♀.—Sydney, N.W.W., 14.9.06. It carries an apparently unpublished name by Friese, referring to the brown tint of the abdomen.

Nomia nana Smith

♂.—Adelaide, 21.9.06 (Frank). Labeled *N. argentifrons* Smith.

Nomia latetibialis Friese

♂.—Adelaide, 21.9.06 (Frank). A very distinct species, rather suggestive of *N. gracilipes* Smith. The head and thorax are black, but the abdomen is dark red suffused with purple, the third and fourth segments dark dull purple except the red hind margins, while the apex (last two segments) is pale testaceous. There are no hair-bands. The venter is flat and simple, except that the fourth segment is emarginate in the middle, and from beneath the emargination projects a stout curved red spine. Flagellum very long, light ferruginous beneath; tegulae rufofulvous; wings with dark stigma and nervures, a diffused dusky apical cloud; second cubital cell square, receiving recurrent nervure well before end; hind legs not greatly swollen, their tibiae trigonal; legs dark reddish brown. The specific name is derived from the fact that the hind tibiae bulge anteriorly, making the outer face unusually large.

Nomia generosa Smith

♂.—Mackay, Queensland, 1900. It carries an apparently unpublished name by Friese, referring to the mandibles (which are bright castaneous). The specimen is in bad condition, but I think it is *N. generosa*. The flagellum is very long, dark; tegulae large, rather dark rufous; tibiae and tarsi bright castaneous, the anterior and middle tibiae clouded with dusky; hind legs little swollen, but the femora conspicuously curved, the tibiae trigonal; wings dusky; abdominal hair-bands narrow. Near to *N. mærens* Smith, but distinct. Smith thought it might be the male of *N. mærens*.

Haliplus clariventris Friese

Both sexes from Adelaide, 21.9.06 (Frank). Friese described the female, but sent the male as a *Nomia*, with an apparently unpublished specific name referring to the very small size. Before I noticed the female, I had concluded that the male must belong to *H. granulithorax* Cockerell, known only in the female. The female is indeed excessively near to *H. granulithorax*, but considerably smaller, without the strong median sulcus on anterior part of mesothorax, while the first abdominal segment is considerably more shining, and the scutellum is entirely dull except the anterior margin. Under the microscope, the area of metathorax has a fine reticulate sculpture, while the first abdominal segment

is minutely transversely lineolate (in *H. granulithorax* it is excessively densely punctured all over). Thus, in spite of the close resemblance, these species are quite distinct. The male *H. clariventris* resembles *H. victoriellus* Cockerell, being one of those forms with broad abdomen, looking like a female. It is easily known from *victoriellus* by the broader, very dull mesothorax, by the dense covering of white hair on the face (including the clypeus), and by the all black tegument of the clypeus. The flagellum is shorter, dusky reddish beneath. The tarsi are rather pale brown. Both species have a bidentate or bilobed structure at end of abdomen.

The dense white hair on the face of the male suggests *H. niveifrons* Cockerell, but from that species *H. clariventris* is easily separated by the pale testaceous stigma with dusky margin, that of *niveifrons* being very dark. Also, *H. niveifrons* has a shining mesothorax.

***Halictus leichardti* Cockerell**

NEW SYNONYM.—*Halictus scutellatus* Friese. Mackay (Turner)..

***Halictus blackburni* Cockerell**

NEW SYNONYM.—*Halictus crinitus* Friese. Mackay (Turner).

***Halictus sturti* Cockerell**

NEW SYNONYM.—*Halictus globularis* Friese. Mackay, at flowers of *Cassia* (Turner).

***Halictus musicus* Cockerell**

NEW SYNONYM.—*Halictus trimaculatus* Friese. Central Australia (von Müller).

***Halictus cassiæfloris* Cockerell**

NEW SYNONYM.—*Halictus tenuis* Friese (not Ellis). Mackay, at flowers of *Cassia* (Turner).

***Halictus davidis* Cockerell**

NEW SYNONYM.—*Halictus nigroscopaceus* Friese. Female, Malanda, Queensland (Mjöberg). Male, Cairns, Queensland.

***Halictus eyrei* Cockerell**

NEW SYNONYM.—*Halictus claripes* Friese. Mackay (Turner).

***Halictus dampieri* Cockerell**

NEW SYNONYMS.—*Halictus strangulatus* Friese and *Halictus indigoteus* Friese. Mackay (Turner).

H. strangulatus is typical *H. dampieri*. *H. indigoteus* is the common variation with bluish-green mesothorax.

***Halictus vitripennis* Smith**

NEW SYNONYM.—*Halictus sphecodoides* var. *mackayensis* Friese. Mackay (Turner). *H. vitripennis* was described from Champion Bay, W. Australia, but those of the east coast seem not to differ.

***Halictus franki* Friese**

♀.—Freemantle, W. Australia, 20.8.06 (Frank). A second specimen, which has lost the abdomen, but is evidently the same species, is labeled Sydney, 14.9.06 (Frank). It carries a manuscript name by Friese, referring to it as Australian. I assume that Friese withdrew the latter from publication, finding it to be identical with *H. franki*, and I venture to suspect that the Sydney label is erroneous. The species is a valid one, and is one of those near the border line between *Halictus* and *Parasphcodes*. Superficially, it looks like *Parasphcodes plorator* Cockerell, but the area of metathorax is quite different. It may be known by the broad short shining abdomen, very finely and closely punctured, without hair-bands or spots. The hind tibiae have pure silver-white hair on the inner face, and the hair on inner side of basitarsi is creamy white. The apical part of the abdominal venter has thin pure white hair. The hind spur has short noduliform teeth. The wings are distinctly dusky, with dark stigma; the first recurrent nervure meets the second intercubitus. The mesothorax is excessively densely punctured all over. Tegulae dark rufous; face broad; antennae dark. There is some similarity to the Tasmanian *H. littleri* Cockerell, but that has patches of white pubescence laterally at bases of second and third tergites, and the mesothorax is more coarsely punctured.

***Halictus griseovittatus* Cockerell**

NEW SYNONYM.—*Halictus mjobergi* Friese. The specimen is labeled Adelaide (Mjöberg); but Friese, reporting on Mjöberg's collection (1917), cites only Queensland localities. The species is a well-known Queensland form, and I doubt the Adelaide record.

Halictus erythrurus Cockerell

♀.—Two from Sydney, 14.9.06 (Frank); labeled *H. sphecodes* Smith, but not that species, which has the apical part of abdomen dark. I have examined Smith's type. This species is very like two found by Mr. T. Rayment in Victoria, the three females, each with the metathorax black, being separable thus:

- 1.—Clypeus highly polished, anterior tibiae mainly dark, but knees red.
erythrurus Cockerell.
- Clypeus dull or dullish. 2.
- 2.—Anterior tibiae clear red in front; abdomen with no basal dark patch.
tarltoni Cockerell.
- Anterior tibiae dark; abdomen broadly black at base. *raymenti* Cockerell.

Halictus luteoæneus Friese

♀.—Victoria (von Müller). A very distinct species, rather recalling some of the Polynesian forms. It is about as large as *H. flindersi* Cockerell; head and thorax golden green, with coppery tints on clypeus and posterior part of mesothorax; flagellum black, but basal half of scape clear red; mesothorax highly polished, with scattered punctures; disc of scutellum almost impunctate; area of metathorax shining, with coarse plicatulate sculpture; posterior face shining green, with a small but conspicuous brassy patch at its upper end; tegulae clear rufofulvous; wings clear, with dark brown stigma; third cubital cell very short, much higher than long; first recurrent nervure meeting second intercubitus; legs, except base, clear ferruginous; hind femora deformed, broad basally, and bent in middle, anterior face largely green; abdomen shining green, curled ventral scopa large.

Halictus forresti Cockerell

NEW SYNONYM.—*Halictus scutellatus* Friese, ♂ (not ♀), Mackay, Queensland (Turner). The abdomen is very dark reddish, and it is a question whether the species would not be better placed in *Parasphecodes*.

Parasphecodes basilautus Cockerell

NEW SYNONYM.—*Halictus pilicollis* Friese. Cairns, Queensland.

Parasphecodes infrahirtus Cockerell

NEW SYNONYM.—*Halictus obscuripes* Friese, ♂. Adelaide, 21.9.06 (Frank). The species was originally described from Tasmania.

***Parasphecodes subrussatus* Cockerell**

Friese's male of *Halictus gibbosus* is this species, but the fourth abdominal segment has a transverse black patch like that on the third. The locality Rosciusko, given by Friese, is evidently the same as my type locality, Kesciusco. Friese's specimen was collected by R. Helms. Friese's *H. gibbosus* must be restricted to the female, a quite different species, described first and at greater length.

***Parasphecodes gibbosus* (Friese)**

Halictus gibbosus Friese, ♀ (not ♂). Sydney, N.S.W., 14.9.06 (Frank). This is a valid species; the hump on the first tergite, referred to by Friese, is obscure, but the structure is peculiar, with a keel running up the middle of the highly polished basal declivity of the segment, terminating in a sort of little boss which is not distinctly elevated. Broad and robust, hair of head and thorax above dull ochreous; mandibles slightly reddish apically; clypeus shining, with large punctures, but supraclypeal area granular and dull, antennæ entirely black; mesothorax dull, excessively finely and densely punctured; scutellum slightly shining, with a median sulcus; metathorax not dentate at sides, its area large, hardly defined, entirely dull, with coarse rugæ; posterior truncation polished and shining; tegulæ rufofulvous; wings strongly dusky, somewhat reddish; a fairly distinct apical cloud; stigma pale dull ferruginous, nervures fuscous; first recurrent nervure meeting or falling short of second intercubitus (varying on the two sides); legs black, with mainly ochreous hair; abdomen entirely very dark red (almost purplish red), excessively minutely and closely punctured, without hair-patches.

In Meyer's table (1920) thus runs to *P. tepperi* Cockerell, differing by the robust form and black flagellum. *P. speculiferus* Cockerell, has a brighter red abdomen, and entirely different area of metathorax.

***Parasphecodes fultoni* Cockerell**

NEW SYNONYM.—*Halictus rubriventris* Friese. Ararat, Victoria, ♀. It differs a little from my type of *P. fultoni*, in having the area of metathorax somewhat shorter, and a distinct transverse black mark on disc of first tergite. So far as I can make out from the description, *P. punctatissimus* Mayer, 1920, seems to be the same species.

***Parasphecodes tamburinei* (Friese)**

♀.—*Halictus tamburinei* Friese, 1917. Mt. Tambourine, Queensland (Mjöberg). *Parasphecodes paramelænus* Cockerell, 1922, is a

synonym. Friese had taken *Binghamiella* for *Parasphecodes*, and referred all the real *Parasphecodes* to *Halictus*. It must be admitted that, while typical *Parasphecodes* are easily recognized, the black species, such as the present one, are not sharply distinguished from *Halictus*. Studies of the mouth-parts, genitalia, and other structural features are needed; but the material now available is too scanty for such an undertaking.

***Parasphecodes rufulus* (Friese)**

♂.—*Halictus rufulus* Friese. Victoria. Friese also cites it from Mackay, but I now designate Victoria as the type locality. The specimen agrees with the description. This looks like the male of *P. fulltoni* Cockerell, and I should have been inclined so to refer it but for the fact that the truncation of the metathorax is not polished, but sculptured all over, though moderately shining. It agrees with the description of *P. talchius* Smith except that the abdomen is not black at base, and only the second tergite is depressed at base. The tegulæ are a fine rufofulvous, and the very long antennæ are entirely black. The first recurrent nervure meets the second intercubitus. The tibiæ and tarsi are red.

***Parasphecodes fulviventris* (Friese)**

♀.—*Halictus fulviventris* Friese. Melbourne, Victoria. Very closely allied to *P. arciferus* Cockerell, with the same large tubercle on second ventral segment, but larger and more robust, with the abdomen very dark, nearly black, with the first two tergites posteriorly broadly castaneous, and the third very obscurely reddish apically. The wings are conspicuously dusky apically; the stigma is reddish black, much darker than in *P. arciferus*. The venation is practically the same as in *P. arciferus*. There is also much resemblance to *P. tilachus* Smith, from Tasmania.

***Palæorhiza turneriana kurandensis* Cockerell**

NEW SYNONYM.—*Prosopis purpurascens* Friese, ♀. Kuranda, Queensland, 1904. The subspecies was originally described from the male.

***Palæorhiza reginarum* (Cockerell)**

Mackay, Q., at *Cassia* (Turner). It carries an apparently unpublished name by Friese, referring to the blue color. It was, however, published under the similar name *Prosopis cærulescens* Friese.

***Palæorhiza disrupta* (Cockerell)**

Described as a variety of *P. parallela* Cockerell, but I think it is a distinct species.

Palæorhiza disrupta var. **rejecta**, new variety

♀.—Hind tibiæ without yellow, and the others with very little yellow; yellow marks on scutellum narrower, and yellow of postscutellum with no dark central mark.

Cairns, Queensland.

Labeled *Prosopis elegantissima* Dalla Torre, which is a quite different species from New Guinea.

Palæorhiza parallela (Cockerell)

NEW SYNONYMS.—*Prosopis regina* Friese, ♀, Mackay, at flowers of *Cassia* (Turner); and *Prosopis regalis* Friese, ♂, Mackay (Turner, 616). The specimen sent lacks the yellow mark behind the tubercles, and is var. *humeralis* (Friese).

Palæorhiza parallela var. **optima**, new variety

♀.—Abdomen blue and splendid purple; first tergite purple, apically blue, second purple at base and apex, third blue with purple apex, and extreme base green, fourth and fifth green with broad purple margin. No yellow mark behind tubercles.

Mackay, Queensland, May, 1900 (Turner).

Sent as *Prosopis regina* var. *humeralis* Friese, but the real *humeralis*, as shown by Friese's description, and by specimens with same data in my collection, is typical *P. parallela* except for the lack of the mark behind tubercles. The variety *optima* is merely an extreme variation, not in any sense a subspecies. The male *humeralis* cited above is transitional to *optima*.

Hylæus alcyoneus (Erichson)

SYNONYM.—*Prosopis chalybæa* Friese, ♂ (not ♀). Australia.

Hylæus fijiensis (Cockerell)

NEW SYNONYM.—*Prosopis chalybæa* Friese, ♀ (not ♂) "N. Seeld. (Riedtm.)." In 'Bees' CXI (Ann. Mag. Nat. Hist., June, 1926) I restricted *P. chalybæa* to the female. It is exactly like *H. fijiensis*, except that the tubercles have only an excessively small yellow mark, instead of being largely yellow or orange. The true home of this species is in doubt. My type was labeled as from the Fiji Islands. Recently I saw a specimen labeled Rye, Victoria. Now comes one from New Zealand. Certainly it cannot be native in all these localities.

Hylæus (Prosopisteron) scrotinellus (Cockerell)

Specimens of *Prosopis maculipennis* Friese confirm this name as a synonym; I had already determined the synonymy from the description. Mackay, Queensland.

Hylæus perplexus (Smith)

NEW SYNONYM.—*Prosopis major* Friese, ♀. Sydney, N.S.W., 14.9.06.

Hylæus (Euprosopis) elegans (Smith)

NEW SYNONYM.—*Prosopis flaviceps* Friese. Specimens sent are males from Roebourne, W. Australia, and Ararat, Victoria.

NEW SYNONYM.—*Prosopis rollei* Cockerell. I now conclude that this is at most a variation. The red scutellum and postscutellum are shown in Friese's specimen from the same locality (Ararat). Are they not due to discoloration by cyanide?

Hylæus nubilosus subnubilosus (Cockerell)

♀.—Mackay, at *Eugenia* (Turner, 271). Sent as *Prosopis nubilosa* Smith.

Hylæus nubilosus aureomaculatus (Cockerell)

♂.—Mackay (Turner). Sent as *Prosopis nubilosa* Smith.

Hylæus xanthaspis (Cockerell)

NEW SYNONYM.—*Prosopis turneri* Friese. Mackay, on *Cassia* (Turner, 13a).

Two specimens (♀) of *P. mackayensis* Friese differ by the lemon-yellow (instead of orange) scutellum and postscutellum; the abdomen is obscurely metallic, and the face wholly without light markings. They were taken by Turner at Mackay, March, 1900. The actual types of *P. mackayensis* (as cited by Friese) were taken in December and January. Friese notes that *turneri* is probably a variety of *mackayensis*. There is a yellow spot on the axillæ of *mackayensis*; this may be present or absent in *H. xanthaspis*. After careful study, I am unable to see more than one species in this lot, and I regard both the Friese names as synonyms.

Hylæus chrysognathus (Cockerell)

NEW SYNONYM.—*Prosopis capitata* Friese, ♂. Ararat, Victoria.

Hylæus nubilosellus mediostictus (Cockerell)

NEW SYNONYM.—*Prosopis sydneyensis* Friese, ♀. Sydney, 14.9.06 (Frank).

Hylæus trilobatus (Cockerell)

NEW SYNONYM.—*Prosopis centralis* Friese, ♂. Dandenong Range, Victoria.

Hylæus eugeniellus (Cockerell)

NEW SYNONYM.—*Prosopis nana* Friese, ♀. Mackay, October (Turner).

Meroglossa penetrata percrassa (Cockerell)

♀.—Mackay, at flowers of *Xanthorrhæa* (Turner, 273). Sent as *Prosopis penetrata* Smith. It has two small cream-colored marks on the clypeus, and a red spot between antennæ.

Meroglossa (Meroglossula) eucalypti Cockerell

NEW SYNONYM.—*Prosopis disjuncta* Friese (not Cockerell, 1905), Mackay (Turner, 454) ♀.

Meroglossa (Meroglossula) sculptissima (Cockerell)

NEW SYNONYM.—*Prosopis striaticeps* Friese, ♀. Mackay, at *Xanthorrhæa* (Turner, 1049).

Euryglossa leptospermi (Cockerell)

NEW SYNONYM.—*Stilpnosoma laterale* Friese, ♀. Mackay (Turner, 859).

Euryglossa sanguinosa (Cockerell)

NEW SYNONYM.—*Stilpnosoma variegatum* Friese, ♀. Mackay, at *Leptospermum* (Turner, 867).

Euryglossa aurescens (Cockerell)

NEW SYNONYM.—*Stilpnosoma thoracicum* Friese, ♀. Mackay (Turner, 701).

Euryglossa chrysoceras (Cockerell)

NEW SYNONYM.—*Stilpnosoma piceum* Friese, ♂. Colo (or Cola?) Vale, N.S.W., 1902 (B. Corrie).

Euryglossa fasciatella (Cockerell)

NEW SYNONYM.—*Stilpnosoma nigrum* Friese, ♀ (not *Euryglossa nigra* Smith). Adelaide, 21.9.06 (Frank).

Euryglossa reginæ (Cockerell)

Friese's *S. piceum* seems from the description to be *E. chrysoceras*, as indicated by the specimen cited above, but the material also included *E. reginæ*. A specimen of *E. reginæ* labeled *S. piceum* is from Mackay, September (Turner).

Euryglossa edwardsii Cockerell

A specimen from Mackay, at *Leptospermum*, October (Turner, 2a) is labeled with an unpublished name by Friese, indicating its occurrence in Adelaide. It is not *S. adelaidæ* Friese.

Euryglossa subsericea Cockerell

NEW SYNONYM.—*Stilpnosoma ventrale* Friese, ♀. Mackay, at *Leptospermum*, October (Turner, 702x).

So far as I can see, *S. turneri* Friese [♂, Mackay, at *Leptospermum*, (Turner, 1a) and ♀, Mackay, Nov. (Turner)] is also *E. subsericea*. The male, as Friese remarks, has a blue-green head and thorax, which is not at all true of the female. In Ann. Mag. Nat. Hist., Aug., 1910, p. 168, I commented on this circumstance, but concluded (as did Friese quite independently) that the male really belonged with ♀ *E. subsericea*. If this is wrong (and I am not certain), it will be proper to call the metallic species (Turner, 1a) *Euryglossa turneri* Friese. This choice is justified by my 1910 allusion to Friese's species.

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NEW AND LITTLE-KNOWN MAMMALS FROM THE MIOCENE OF AFRICA¹

BY A. TINDELL HOPWOOD

The remains described in the following pages were collected by Mr. Herbert Lang in the Namib, south of Lüderitz Bay, South West Africa, with the assistance of Dr. Beetz, the original discoverer of this fossil field. For the privilege of examining them I am indebted to the kindness of my friends Professor Henry Fairfield Osborn and Dr. George Gaylord Simpson. To both these gentlemen I here tender my heartiest thanks. The drawings were made by John Germann.

The specimens are very fragmentary and some are worn and eroded by wind-driven dust and sand. They are supplementary to the collections made by Professor Kaiser and Dr. Beetz in the same area, described by Stromer,² and, like them, are most probably of Lower Miocene age.

The Lower Miocene mammals of the Namib, so far as known, are listed below.

CREODONTA

Metapterodon kaiseri Stromer.

Gen. et sp. indet. (Auct. Stromer).

RODENTIA DUPLICIDENTATA

Austrolagomys inexpectatus Stromer.

Austrolagomys simpsoni Hopwood

RODENTIA SIMPLICIDENTATA

Parapedetes namaquensis Stromer.

Bathyergoides neotertiarius Stromer.

Neosciuromys africanus Stromer.

Phiomysoides humilis Stromer.

Apodecter stromeri Hopwood.

Phthinylla fracta Hopwood.

cf. *Phiomys andrewsi* Schlosser. (Auct. Stromer).

Diamantomys luederitzi Stromer.

Ponomomys dubius Stromer.

PERISSODACTYLA

Rhinocerotid indet. (Auct. Stromer).

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²Stromer, E. 1926. Reste land- und süßwasser-bewohnender Wirbeltiere a. d. Diamantenfeldern Deutsch-südwestafrikas. In Kaiser, E., "Die Diamantenwüste Südwestafrikas," II, pp. 107-153. Berlin, 1926.

ARTIODACTYLA

Diamantohyus africanus Stromer.

?*Propalæochærus* sp. (Auct. Stromer).

Tragulid indet. cf. *Dorcatherium* (Auct. Hopwood).

Tragulid indet. cf. *Bacchitherium*. (Auct. Hopwood).

cf. *Strogulognathus* sp. (Auct. Stromer).

Propalæoryx austroafricanus Stromer.

HYRACOIDEA

Prohyrax tertiarius Stromer.

Myohyrax oswaldi Andrews. (Auct. Stromer).

Myohyrax doederleini Stromer.

Myohyrax osborni Hopwood.

Protypotheroides beetzi Stromer.

RODENTIA DUPLICIDENTATA

Ochotonidæ

Austrolagomys simpsoni, new species

TYPE.—Amer. Mus. No. 22528a, broken mandibular ramus with P₃–M₃.

PARATYPE.—Amer. Mus. No. 22528b, part of right ramus with P₃–4.

HORIZON AND LOCALITY.—Lower Miocene, south of Lüderitz Bay, South West Africa.

DIAGNOSIS.—An *Austrolagomys* in which P₃ has a deep external fold, and P₄–M₂ show a marked angulation, or rib, in the enamel of the hinder surface of the anterior pillar. M₃ square in cross section, placed obliquely to the other teeth

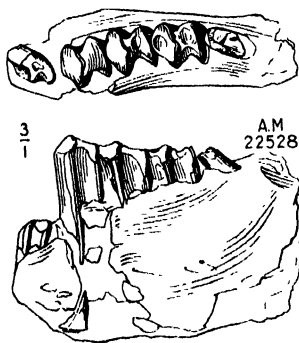


Fig. 1. *Austrolagomys simpsoni*, new species. Left lower jaw with P₃–M₃. Type. Crown and external views. Three times natural size.

This species is slightly smaller than *A. inexpectatus* Stromer, from which it differs in having a deeper fold on P₃, an angulation in the enamel of the hinder surface of the anterior pillars of P₄–M₂, and in the outline of M₃, which is square rather than oval in cross-section.

The trivial name is given in honor of my friend Dr. G. G. Simpson.

DIMENSIONS

	P ₃	P ₄	M ₁	M ₂	M ₃	P ₄ –M ₃
Type { Length	1.4	1.6	1.9	1.8	0.7	6.1
{ Breadth	1.3	1.7	1.9	1.9	0.7	—
Paratype { Length	1.5	1.8	—	—	—	—
{ Breadth	1.2	1.7	—	—	—	—

RODENTIA SIMPLICIDENTATA

Apodecter, new genus

DIAGNOSIS.—Simplicidentate rodents with quadricuspidate lower molars. Teeth brachyodont, one outer and two inner valleys; a slight anteroexternal cingulum on M_1 and M_2 , external valley directed backward, internal valleys directed forward. Hinder half of M_3 reduced.

TYPE.—*A. stromeri*, new species.

This genus differs from *Phiomysoides* in the proportions of the teeth, in the presence of an anteroexternal cingulum, and in the presence of a hypoph. It differs from *Paraphiomys* in the absence of accessory tubercles in the inner valleys, in its smaller size, and in the proportions of the teeth.

Apodecter stromeri, new species

TYPE.—Amer. Mus. No. 22538, part of a right mandibular ramus with the first two molars slightly worn and the third uncut but fully displayed in the crypt.

HORIZON AND LOCALITY.—Lower Miocene, south of Lüderitz Bay, South West Africa.

DIAGNOSIS.—As for the genus.

The two outer cusps are roundly triangular in section, with the apex of the triangle on the outer side of the tooth, and the shortest side to the front. Each cusp has an antero- and posterointernal ridge. The ridges from the protoconid meet those from the metaconid and entoconid, and the anterior ridge from the hypoconid meets that from the entoconid. The posterior ridge from the hypoconid is confluent from the hypoph. Ridges pass inward from the metaconid and entoconid at right angles to the anteroposterior axis of the tooth. They meet those from the protoconid and hypoconid in the midline of the crown.

The external fold is broad and directed slightly backwards; the folds on the inner side of the tooth are equally broad and have their ends pointing forwards.

Consisting essentially of two large anterior cusps, the third lower molar has its hinder half considerably reduced. The hypoconid is at the extreme end; a position which gives the tooth a triangular outline. The entoconid is very small. On account of their arrangement, of the nature of the deep anterointernal fold, of the less deep external fold,



Fig. 2. *Apodecter stromeri*, new genus and species. Right lower jaw with M_{1-3} . Type. Crown view. Five times natural size.

and of the small, shallow, posterointernal one, ridges connect metaconid and protoconid, and protoconid and entoconid. The hypoconid is detached, with a minute hypoph on its inner surface.

The generic name is the Greek ἀποδερῆρ, a tax-collector, and is appropriate to property-devouring vermin. The trivial name is given in honor of Professor Ernst Stromer, who was the first to describe mammalian remains from the Lower Miocene of South West Africa.

DIMENSIONS

	M ₁	M ₂	M ₃
Type { Length	1.4	1.4	1.1
{ Breadth	1.4	1.3	1.1

Phthinylla, new genus

DIAGNOSIS.—Simplicidentate rodents with quadricuspidate upper cheek teeth. Teeth moderately hypsodont; with two outer valleys and one inner valley; postero-external valley wide, divided by a strong crest which nearly reaches the labial surface.

TYPE.—*P. fracta*, new species

This genus differs from *Paraphiomys* in being smaller and in having teeth which are relatively more hypsodont. The crest in the posterior valley corresponds with the small projection or crest seen in the antero-internal valley of *Paraphiomys*, but is very much larger and stronger.

Phthinylla fracta, new species

TYPE.—Amer. Mus. No. 22539, part of left maxilla with first two cheek teeth.

HORIZON, AND LOCALITY.—Lower Miocene, south of Lüderitz Bay, South West Africa.

DIAGNOSIS.—As for the genus.

Phthinylla, from its close resemblance to *Paraphiomys*, may be placed among the Theriodomyidæ. On the other hand, my colleague Mr. M. A. C. Hinton considers that both *Phthinylla* and *Apodecter* might quite well be considered as primitive murines.

The generic name is the Greek φθινυλλα, an old hag.



Fig. 3. *Phthinylla fracta*, new genus and species. Left upper jaw with first two cheek teeth. Type. Crown view. Three times natural size.

RODENTIA INCERTÆ SEDIS

In addition to the remains described above there are fragments of at least four indeterminate species in the collection. One specimen,

Amer. Mus. No. 22541, is an almost complete hind foot which is large enough to justify a tentative though doubtful reference to *Parapedetes* Stromer, but the tarsus is fractured and some parts of the bones lost. The other specimens are, in the main, isolated upper and lower incisor teeth.

ARTIODACTYLA

Artiodactyl ungulates are represented by foot bones and fragments of lower jaws. None are identifiable with certainty, but all appear to be ruminants. The teeth belong to tragulids.

Tragulidæ

There are at least two types of tragulids in the collection. The first form is represented by a left mandibular ramus with the broken and worn P_3 - M_3 preserved, Amer. Mus. No. 22527. P_3 is entirely lost except for the posterior root, and only the hinder two-thirds of the lingual surface of P_4 remains. The latter tooth has a deep postero-internal fold which passes obliquely forward, thus distinguishing it from the holotype of *Dorcatherium nawi* Kaup (Regd. 40632 Brit. Mus. Geol. Dept.), from which it also differs in its slightly greater size. Externally there are basal tubercles on M_{2-3} , and there was a posteroexternal rib on M_3 .

	DIMENSIONS			
	M_1	M_2	M_3	M_{1-3}
Length	11	13.5	21	46 mm.
Breadth	—	9	9	— mm.

A second, smaller tragulid is represented by Amer. Mus. No. 22525, a partial left mandible with the alveoli for P_2 , broken P_{3-4} , and much worn M_{1-3} , and Amer. Mus. No. 22526, including part of an isolated lower premolar, partly worn associated M_{1-2} , an isolated broken M_3 , and a broken and weathered upper molar. This form has some resemblance to *Bachitherium* of the European Miocene, but the material is too worn to allow close comparison.

	DIMENSIONS			
Amer. Mus. No. 22525	M_1	M_2	M_3	M_{1-3}
Length	6.3	8	11	26
Breadth	4.8	5.5	5.5	—

MYOHRACOIDEA**Myohyracidae****Myohyrax doederleini** Stromer

Six fragments of lower jaws, Amer. Mus. No. 22534, and three upper molars, Amer. Mus. No. 22535, are referred to this species.

The most important mandibular fragments are an anterior portion with the first two left incisors and a styliform P_2 , and a broken left mandible with P_3 - M_2 entire and M_3 broken off short in the alveolus. The incisors are procumbent; I_1 is chisel-shaped and I_2 subspatulate. Both are convex and covered with enamel on the labial surface, whereas their lingual surfaces are either flat (I_1) or gently concave (I_2) and entirely devoid of enamel. The second lower premolar is a simple slender

cone. From P_3 to M_2 the teeth have each two roots. Their crowns increase in height to M_1 and then decrease. Each tooth is long and narrow, with a deep fold on the labial and lingual surfaces. That on the labial surface is slightly anterior to that on the lingual surface. The two grooves are almost confluent, the enamel of one being separated from that of the other by a film of dentine only distinguishable



Fig. 4. *Myohyrax doederleini* Stromer. Part of left lower jaw with I_{1-2} and P_2 . Referred specimen. Crown view. Five times natural size.

with certainty under a high-power binocular microscope. These grooves give the teeth the appearance of being composed of two pillars which are subcircular in outline and joined by a very narrow neck. The inner surface of the anterior pillars is slightly concave; all other surfaces are strongly convex. M_3 was reduced to a single pillar.

The upper teeth show no details additional to Stromer's description.

Myohyrax osborni, new species

TYPE.—Amer. Mus. No. 22532, a left maxilla with P_3 - M_2 .

PARATYPE.—Amer. Mus. No. 22529, parts of a left mandibular ramus with P_4 and M_2 .

HORIZON AND LOCALITY.—Lower Miocene, south of Lüderitz Bay, South West Africa.

DIAGNOSIS.—A *Myohyrax* in which P^3 - M^2 measures 19.5 mm. Lower molars with an island of enamel in each pillar; pillars flat or slightly concave on the lingual surface, strongly convex on the labial surface.

The fourth upper premolar is completely molariform and presents no special features. P^3 is not quite so complicated as the other teeth. It has four cusps, but no styles. There is one external rib, which is formed by the tritocone. Two islands of enamel on the grinding surface are near the tritocone and tetartocone respectively; the former is divided into a larger anterior and a smaller posterior portion. A narrow groove in the anterior surface separates protocone and deuterocone, and a second, somewhat broader and shallower groove is on the anterior surface of the deuterocone.

Apart from their much greater size, the remaining cheek teeth bear a close resemblance to those of the other species of *Myohyrax*. They are markedly hypsodont, each with four roots, which are grooved on the inner surfaces. Their crowns are prismatic and subquadrate; the

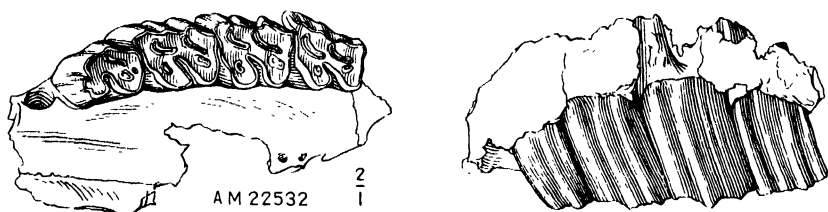


Fig. 5. *Myohyrax osborni*, new species. Left upper jaw with P^3 – M^2 . Type. External and crown views. Twice natural size.

anterior and labial sides longer than the posterior and lingual. There is a well-marked parastyle and a smaller metastyle, but no mesostyle; between the parastyle and metastyle are two strong ribs formed by the paracone and metacone. Each tooth has four islands of enamel on the occlusal surface, one by each of the four cusps. Those by the paracone and metacone—the two external islands—are crescentic and placed obliquely with regard to the long axis of the tooth, the anterior end being outermost. The two inner islands are almost circular.

A second specimen of a maxilla, Amer. Mus. No. 22533, is similar to the type. Expressing the breadth as a percentage of the length, and comparing with the corresponding ratios of the type, it is seen that the teeth are slightly narrower:

Number	P^4	M^1
22532	76.5	83.8
22533	73	80

The lower cheek teeth differ from those of *M. oswaldi* and *M. doederleini* and, in some respects, resemble those of the genus *Protypotheroides*. Each pillar is strongly convex on the labial side and almost

flat lingually, and each has an island of enamel on the occlusal surface. The longest diameter of the pillars is oblique with reference to the long axis of the mandible, the anterior end being the external one.

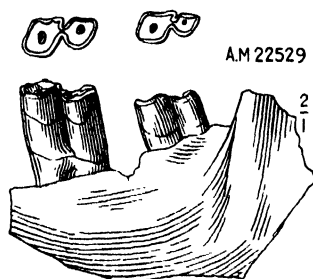


Fig. 6. *Myohyrax osborni*, new species. Left lower jaw with P₄ and M₂. Paratype. External view and occlusal surface of the teeth. Twice natural size.

DIMENSIONS

Type, Amer. Mus. No. 22532.

	P ³	P ⁴	M ¹	M ²
Length	3.9	5.5	5.5	5.3
Breadth	3.7	4.2	4.6	4.9

Paratype, Amer. Mus. No. 22529:

	P ₄	M ₂
Length	5.0	4.4
Breadth	2.4	2.1

HABITS OF *Myohyrax*

From characters of the teeth it is evident that *Myohyrax* differed from *Procavia* both in habits and skull structure. The incisors of the latter genus have, when unworn or partly worn, a comb-like appearance, the upper part of each crown being composed of three pegs. As wear proceeds, the teeth of the lower jaw oppose the lingual surfaces of the curved, triangular upper teeth, and become worn in such a manner that the occlusal surface is practically at right angles to the long axis of the tooth, but more on the labial surface. The outline is that of a slightly oblique cross-section of the tooth, and varies from an oval to an irregular oblong. In *Myohyrax* the occlusal surface is on the lingual side of the tooth, is nearly parallel to the long axis, and is triangular in outline. Added to these distinctions are differences in the distribution of the enamel on the incisors of the two genera. *Procavia* has the upper portion of the crown entirely surrounded by enamel, but, as wear proceeds, the tooth, which roots late in life and is of semi-persistent growth, is

further extruded from the jaw; it gradually loses the enamel on the sides, until, in old animals, only the labial and lingual surfaces are covered. *Myohyrax*, on the other hand, never has any enamel on the lingual surface of the incisors, and the differential wear keeps the teeth sharply chisel-edged as in the rodents.

The upper incisors of *Myohyrax* bore no resemblance to those of *Procavia*; they were pro-odont, projecting forward and downward, so as to form with the lower teeth a pincer-like equipment for picking up and hulling hard seeds.

The cross-ridged grinding surface of the cheek teeth of *Myohyrax* is evidence for a considerable amount of lateral movement of the jaws. This movement, if it exists at all, is very limited in *Procavia*, in which genus the jugal bears a descending process which closes the outer end of the glenoid fossa and which articulates with the mandibular condyle. On the other hand, the plane of wear of the incisors of *Myohyrax* indicates that the mandible was also moved in an anteroposterior direction. Combining the two motions, it seems probable that *Myohyrax* first picked up seeds by means of the incisors, which were moved back and forth to prepare the material by removing the outer shell. The cheek teeth were then moved mainly in a transverse direction, and ground the food into a consistency suitable for swallowing. This is bound to have affected the shape of the glenoid cavity, which, if ever discovered, should prove to be broad and shallow, as in the ruminants and the majority of rodents, and not on the hinge type of *Procavia*.

CONCLUSIONS

The fossils described above emphasize Professor Stromer's conclusions that the fauna was a rich one, apparently living under savanna conditions, as shown by the presence of antelopes (*Propalaeoryx* Stromer) and jumping hares, with sheltering woodland bordering the water-courses indicated by the tragulid remains.

56.9(1181.78.6)

THIRD CONTRIBUTION TO THE FORT UNION FAUNA AT BEAR CREEK, MONTANA

BY GEORGE GAYLORD SIMPSON

In two previous papers,¹ the discovery of a new Paleocene mammalian fauna at Bear Creek, Montana, has been announced and discussed. During the summer of 1928 further collections have been made at this locality for the American Museum of Natural History by Miss Rachel A. Husband, of the Department of Vertebrate Palæontology, and by Mr. J. F. Lobdell, superintendent of the Eagle Coal Mine at Bear Creek. These add somewhat to our knowledge, and it is proposed here to describe some new material and to discuss the age and relationships of the whole fauna so far as now known.²

MAMMALIAN FAUNAL LIST

MULTITUBERCULATA

Ptilodontidae

Litotherium complicatum, new genus and species

INSECTIVORA

Plagiomenidae

Planetetherium mirabile Simpson

Nyctitheriidae

Protentomodon ursirivalis Simpson

?Pantolestidae

?*Pentacodon* cf. *inversus* Cope

Leptictidae

Leptacodon (*Leipsanolestes*) *siegfriedti* (Simpson)

?PRIMATES

?Plesiadapidae

?*Plesiadapis* sp.

Labidolemur kayi Simpson

Anaptomorphidae

Carpolestes nigridentis Simpson

Carpolestes aquilæ, new species

TÆNIODONTA

Stylinodontidae

?*Psittacotherium lobdelli*, new species

¹American Museum Novitates, No. 297, Feb. 2, 1928. "A Collection of Paleocene Mammals from Bear Creek, Montana," Annals Carnegie Museum, Art. VI, 1929

²As a matter of possible historic interest, the original discovery was made on Nov. 5, 1926. The first paper (Novitates No. 297, p. 1, line 14) contains an obvious typographic error, 1927 for 1926.

CREODONTA

Oxyclenidae

Thryptacodon pseudarctos Simpson

Mesonychidae

Dissacus cf. *navajovius* Cope

CONDYLARTHRA

Phenacodontidae

Phenacodus cf. *primævus hemiconus* (Cope)

CORRELATION

Bear Creek Mammals	Closest Allies
<i>Litotherium complicatum</i> . . .	{ ? <i>Ptilodontidae</i> —Cretaceous to Lower Eocene.
<i>Planetetherium mirabile</i> .	<i>Plagiomene</i> —Lower Eocene (Gray Bull).
<i>Protentomodon ursirivalis</i> <i>Nyctitheriidae</i> —Lower and Middle Eocene.
? <i>Pentacodon</i> cf. <i>inversus</i> . .	{ ? <i>Pentacodon</i> —Middle Paleocene (Torrejon).
	{ <i>Pantolestidae</i> —Middle Paleocene to Middle Eocene.
<i>Leptacodon</i> (<i>Leipsanolestes</i>) <i>siegfriedti</i>	<i>Leptacodon</i> —Upper Paleocene (Tiffany).
? <i>Plesiadapis</i> . .	{ ? <i>Plesiadapis</i> —Upper Paleocene (Tiffany, Clark Fork).
<i>Labidolemur kayi</i>	<i>Labidolemur</i> —Upper Paleocene (Tiffany).
<i>Carpolestes nigridentis</i> }	<i>Carpodaptus</i> —Upper Paleocene (Tiffany).
<i>Carpolestes aquilæ</i> }	
? <i>Psittacotherium lobdelli</i>	{ <i>Psittacotherium</i> —Middle Paleocene (Torrejon).
	<i>Calamodon</i> —Lower Eocene.
<i>Thryptacodon pseudarctos</i> . . .	{ <i>Thryptacodon</i> —Upper Paleocene (Tiffany, Clark Fork) and Lower Eocene (Sand Coulee, Gray Bull).
<i>Dissacus</i> cf. <i>navajovius</i>	{ <i>Dissacus</i> —Middle Paleocene to Lower Eocene.
<i>Phenacodus</i> cf. <i>primævus hemiconus</i>	{ <i>Phenacodus</i> —Upper Paleocene and Lower Eocene.

Only two forms, ?*Pentacodon* and ?*Psittacotherium*, suggest Torrejon age, but in neither case is reference to the Torrejon genus certain and both belong to groups which range into the Eocene and of which the Upper Paleocene representatives are not available for comparison. They are of no value at present in exact correlation, although the *tæniodont* does appear to be somewhat more advanced than the Torrejon species and somewhat more primitive than those from the Wasatch. *Planetetherium* and *Protentomodon* have their only known allies in the true Eocene, but they do not belong to the Eocene genera and probably will be found to be more closely allied to the otherwise still unknown Upper Paleocene representatives of their families. There are no exclusively

Eocene genera in the fauna as now known. *Litotherium* is of such uncertain exact affinities as to be of little use in correlation. All the other known forms have their closest allies in the Upper Paleocene. The *Phenacodus*, or, at least, phenacodont with a very strong mesostyle, can hardly be older than Upper Paleocene. The cumulative evidence now seems to indicate beyond reasonable doubt that this is the true age of the fauna. It is approximately equivalent to the Tiffany of Colorado, the Clark Fork of Wyoming, the "Erickson's Landing" Paskapoo of Alberta, and the Cernaysian of France.

Resemblance to the Tiffany fauna of southwestern Colorado is especially close. Although they are separated by about 550 miles and neither fauna is very well known, 6 of the known Bear Creek genera also occur in the Tiffany in a closely comparable stage of evolution, while of the six other genera, one (*Carpolestes*) finds its closest ally (*Carpodaptes*) in the Tiffany, and four belong to families not yet discovered in the latter formation (although known to have been present in North America at that time) and give no evidence against correlation. This rather close resemblance is due in part to the fact that both the Tiffany and Bear Creek beds have furnished good microfaunas, whereas the Puerco, Torreon, and Clark Fork microfaunas are less well known. It is, however, valid and, I believe, rather conclusive evidence of essential contemporaneity, since regardless of facies such close resemblance is not found in beds which differ much in age, and since several of the mammals do belong to groups which are known from earlier and from later stages.

The Tiffany and Bear Creek faunas are not of exactly the same facies even though they do both include mostly minute forms (in the Tiffany notably those of the Mason Pocket). The geologic conditions suggest this, the Tiffany being deposited largely by running water and being little carbonaceous, while the Bear Creek deposit is that of a coal swamp and, even in the mammal-bearing clay seam, very highly carbonaceous. The relative abundance of the different types of mammals, given the apparent fact that the faunas are at least of about the same age, proves some difference of facies. In the Mason Pocket, multituberculates, didelphids, and *Plesiadapis* are abundant, while *Carpodaptes* is represented by only one specimen, leptictids (*Xenacodon*, *Leptacodon*) by three, and plagiomenids are unknown. In the Bear Creek Fort Union, multituberculates are rare, didelphids have not been found, and *Plesiadapis* is doubtfully represented by a single specimen, while plagiomenids (*Planetetherium*) are far the most common with *Carpolestes* (very close to *Carpodaptes* in adaptation as in relationship) and leptictids (*Leptacodon*)

next in order of abundance. The evidence of the Tiffany, aside from the Mason Pocket, and of such larger mammals as have left fragmentary remains in the Bear Creek stratum suggests that the general faunas of the two regions may have been similar in character but that the Mason Pocket on the one hand and this particular fossil-bearing layer at Bear Creek on the other represent very special and rather different local facies.

Aside from Bear Creek, the Fort Union has hitherto supplied only one well known fauna, that from Fish Creek in Sweetgrass County discovered by Douglass and worked especially by Silberling.¹ The fine collection in the United States National Museum from this locality (principally Silberling, 1908-1911) has been published by Gidley only in part, but enough has been done to give some conception of the general character and age. Most of the specimens came from near the same level and represent a relatively short span of time. The following genera have been positively identified:

Fish Creek Fauna	Remarks
<i>Ptilodus</i>	{ Genus elsewhere confined to the Torrejon, so far as surely known. Comparable and in some cases apparently identical species.
{ <i>Picrodus</i> <i>Coriphagus</i> <i>Megopterna</i> }	{ Affinities very doubtful. No value in correlation.
<i>Myrmecoboides</i>	{ Leptictidae, Cretaceous to Oligocene. An isolated genus of no precise bearing on correlation.
<i>Promothodectes</i>	{ More primitive than its ally <i>Plesiadapis</i> in the Upper Paleocene.
{ <i>Paromomys</i> <i>Palæchthon</i> }	{ No closely comparable forms elsewhere known in the Paleocene. More primitive than their Wasatch allies.
<i>Elphidotarsius</i>	{ Probably allied to, but if so more primitive than, <i>Carpodaptes</i> of the Tiffany and <i>Carpolestes</i> from Bear Creek.
<i>Neoclænodon</i>	{ Genus elsewhere confined to the Torrejon, so far as known. Species closely comparable.
<i>?Psittacotherium</i>	{ Identification not wholly certain, but species apparently close to one from Torrejon.

¹On the Fish Creek Fauna, see especially:

Douglass, E. 1908. Ann. Carnegie Mus., V, 11-26.
Gidley, J. W. 1909. Proc. U. S. Nat. Mus., XXXVI, 611-626.
1915. Proc. U. S. Nat. Mus., LXVIII, 395-402.
1919. Bull. Amer. Mus. Nat. Hist., XLI, 641-55.
1923. Proc. U. S. Nat. Mus., LXIII, 1-38.
Matthew, W. D. 1914. Bull. Geol. Soc. Am., XXV, 381-402.
1921. Amer. Jour. Sci., (5) II, 209-227.

<i>Miocænus</i>	{	Confined elsewhere to Puerco and Torrejon. Ft. Union includes one indistinguishable from <i>M. acolytus</i> , a Torrejon species.
<i>Anisonychus</i>	{	Elsewhere confined to Puerco and Torrejon. Species doubtful.
<i>Tetracænodon</i>	{	Elsewhere confined to Torrejon. Species comparable.
<i>Pantolambda</i>	{	Elsewhere confined to Torrejon. Species comparable.

The other published material, especially several creodont fragments found by Douglass, is not certainly identifiable as to genus, but is generally of Torrejon aspect. The large amount of unpublished material contains many new and distinctive forms, but none appears to oppose the evidence of the listed genera as to age. The evidence is conclusive that this fauna is of approximately Torrejon age, that is, Middle Paleocene, as already concluded by Douglass, Matthew, and Gidley. It may not be the exact equivalent of either of the two Torrejon fossil levels, but it is certainly later than the known Puerco and earlier than the Tiffany or Clark Fork. It is possibly the equivalent of the lower part of the Torrejon, as would be suggested by the rather meager and indirect stratigraphic evidence noted below.

Despite the fact that they are nominally from the same formation, the Fish Creek fauna is quite unlike that from Bear Creek. Not even one genus is common to the two as now known.¹ This might be due to differences of facies, and doubtless it is in part. But the Fish Creek fauna is represented by a very extensive collection which also is largely made up of the microfauna, many of the members of which are analogous in adaptation to the Bear Creek mammals. If the two deposits were contemporaneous, some closer agreement would surely be expected. Furthermore, in the very clear case of *Phenacodus* as against *Tetracænodon* and the more doubtful but cumulatively important cases of *?Psittacotherium* (advanced type) vs. *Psittacotherium* (Torrejon type), *Carpolestes*—*Elphidotarsius*, and *?Plesiadapis*—*Pronothodectes*, the two faunas do contain members of the same or closely related phyla, and those from Bear Creek are more advanced than those from Fish Creek. The internal evidence therefore seems in agreement with that derived from comparison with the San Juan Basin faunas: the Fish Creek Fort Union fauna is definitely earlier than that from Bear Creek, the former being Middle and the latter Upper Paleocene in age. The two localities are about 65 miles apart.

¹The undescribed material, which I have seen through the courtesy of Dr. Gidley, probably will not alter this statement.

The term "Fort Union" has been very loosely used and it is still uncertain just how much of any given series it should properly include. Its subdivision and correlation have rested largely on stratigraphic data which, in general, are unsatisfactory. The best recent treatment, and one which may form a basis for future work, is that of Thom and Dobbin.¹ They divide the Cretaceous-Eocene transition beds of Eastern Montana as follows:

Wasatch.	{	Ulm Coal Group
	{	Sentinel Butte Shale
Fort Union.	{	Tongue River
	{	Lebo Shale
Lance.	{	Tullock
	{	Hell Creek

The term Fort Union is commonly used to include the Tullock and (or) the Sentinel Butte as well as the limited Fort Union of Thom and Dobbin. In most cases it is difficult to gather from published statements just how much of the column is included in the "Fort Union" of a given locality.

The "Hell Creek Member" of the Lance is the Hell Creek or Lance, *sens. strict.*, of vertebrate palæontologists. No dinosaurs occur in the Tullock, and its champsosaurs, crocodilians, and turtles could be either Paleocene or older. Mammals have not yet been found in this formation. The Tullock is younger than the true Lance or so-called "*Ceratops*" beds,² and from its position it is probably the equivalent of the Puerco. If this proves to be the case, its continued inclusion in the Lance would be quite improper.

The main Fish Creek fauna is from the Lebo, about 30 to 65 feet below the top of this member at Bear Butte.³ The top of the Lebo is, therefore, of Torrejon age. About 50 feet above the base of the Lebo⁴ were found *Clænodon* sp. nov. and *?Mioclænus* sp. These are not certainly diagnostic, but also suggest the Torrejon, so that the entire Lebo may provisionally be considered as of that age. The Lebo is here 1334 feet thick, according to Stone and Calvert.

The Tongue River member has furnished very few fossils. On Fish Creek, about 3000 feet above the "Fish Creek Fauna" or "Gidley-Silberling Quarries" level, and presumably in the Tongue River, Gidley

¹1924. "Stratigraphy of Cretaceous-Eocene Transition Beds in Eastern Montana and the Dakotas," Bull. Geol. Soc. Amer., XXXV, 481-506.

²A very objectionable term, as *Ceratops* does not occur in them.

³Gidley (Bull. Amer. Mus. Nat. Hist., XLI, 550) says 30 feet. Stone and Calvert (Econ. Geol., V, 755) say 65 feet.

⁴Stone and Calvert, *op. cit.*

records *Clænodon ferox* and *Pantolambda ?cavirictis*,¹ both Torrejon species.

Thom and Dobbin state that the vertebrate remains recorded by Lloyd and Hares² from the Fort Union in Billings County, North Dakota, also came from the Tongue River. Gidley identified these as *Tetraclænodon* sp. and *Pantolambda cavirictus*. The remains are poor, but as identified they indicate Torrejon age.

The Sentinel Butte Shale has no previously recorded mammal fauna, although the single tooth from the Fish Creek region named *Tetoniux rex* by Gidley may have come from this member. It was found about 4000 feet above the "Silberling Quarry"—"Gidley Quarry" level, which is said to be in the Lebo. The specimen is quite insufficient to establish the age of the horizon, but it is of Upper Paleocene or even Lower Eocene aspect, and, for the very little that this evidence is worth, agrees with Thom and Dobbin's correlation of this higher "Fort Union" as about equivalent to the Clark Fork or lower Wasatch. The possible age of this member is mentioned again below.

The tentative correlation which one would reach by adding the vertebrate evidence so far adduced to Thom and Dobbin's stratigraphic work would thus be:

Ulm	True Wasatch
Sentinel Butte.	Clark Fork and Tiffany
Tongue River.	} Torrejon
Lebo.	
Tullock.	Puerco

This is very much in need of further palæontologic data before it can definitely be accepted, either as to the correlation or as to the practicability of the suggested division. There is no direct faunal evidence as yet that the Tullock is of Puerco age. The Lebo certainly includes a Torrejon equivalent; but there is no good evidence as to whether the present boundaries correspond to the limits of the vertical range of the Torrejon fauna. The evidence that the Tongue River is also of Torrejon age is rather inconclusive.

To return once more to the bearing of the Bear Creek fauna on the general Fort Union problem, its position in the Tullock-Ulm Coal sequence and its stratigraphic horizon relative to the Silberling and Gidley Quarries (Fish Creek fauna) is not certain.

Woodruff (Bull. U. S. Geol. Sur., No. 341, pp. 92-107) has discussed the Red Lodge Coal Field, in which Bear Creek is located. He states

¹Gidley, *op. cit.*, p. 545. Stone and Calvert, *op. cit.*

²Jour. Geol., XXIII, 538-9.

that the Fort Union is here 8500 feet thick—obviously including some beds not admitted as Fort Union by Thom and Dobbin. Coal Bed No. 3, just above which the mammals occur, would be, by his figures, about 6175 feet above the base and about 2325 feet below the top of the formation. Brown (personal communication) states, on the other hand, that it is about 1500 feet above the base. The datum planes of the two observers are obviously entirely different.

Thom and Dobbin, taking the data given by Woodruff supplemented by unpublished work by Hares, questionably assign 700 feet of Woodruff's section to the Colgate Sandstone and Hell Creek, 4300 to the Tullock and Lebo, no definite thickness to the Tongue River, and 3200 feet to the Sentinel Butte and Ulm Coal. This would place the mammal horizon probably in the Sentinel Butte. If this proves to be its correct position, the fauna furnishes strong and very important confirmation of the approximate contemporaneity of the Sentinel Butte and the Clark Fork.

If this distinctly Paleocene type of fauna does belong in the Sentinel Butte, it would be much more satisfactory from a faunal point of view to retain this member in the Fort Union Formation or Group, rather than to follow Thom and Dobbin in placing it in the Wasatch. Equivalence with the Clark Fork does not necessitate inclusion in the Wasatch. The known Clark Fork fauna may be slightly later than the Bear Creek fauna, although this is not based on any positive evidence and is merely a possibility to bear in mind, but it is still essentially of final Paleocene type. The marked faunal break is between this horizon and the Sand Coulee. The presence of an unconformity in this part of the geologic column usually has little bearing on age unless it is very marked, but there is evidence of at least a local unconformity between the Clark Fork and Sand Coulee. The time break, however, either at the top or bottom of the Clark Fork, is probably negligible, and in this general region there is said to be almost complete continuity between undoubted Cretaceous beds and the true Eocene Wasatch or Upper Wasatch.

In the accompanying table is given a tentative correlation of the mammal-bearing formations of the American Paleocene.

DESCRIPTIONS OF SOME NEW MATERIALS

MULTITUBERCULATA

Ptilodontidæ

Litotherium complicatum,¹ new genus and species

TYPE.—A. M. No. 22196. Isolated last upper premolar? Collected by Miss R. Husband, 1928.

HORIZON AND LOCALITY.—Just above Coal Vein No. 3, Fort Union Group, Eagle Coal Mine, Bear Creek, Montana.

CHARACTERS.—Tooth with three rows of cusps. The largest row (probably internal) with five cusps, forming a shearing edge. A median row, dependent on this, of three cusps, the terminal one poorly differentiated. The shortest row (?external) with two cusps, opposite one end of the longer row, enclosing a basin between themselves and the median row. Enamel wrinkled. Length 3.2 mm., maximum width 2.3 mm.



Fig. 1. *Litotherium complicatum*, new genus and species. Last upper premolar. Type. Crown view. Four times natural size.

Although so isolated, this tooth deserves designation because it is so extraordinary and because it is the best evidence yet obtained of the presence of multituberculates in this deposit. Its affinities are doubtful, but it is very probable that it is a multituberculate of the family Ptilodontidæ. In no other group known to me do teeth even distantly similar occur. The resemblance, so far as it goes, is with the last upper premolar of *Ptilodus*.

If this homology is correct, this tooth of *Litotherium* differs from that of *Ptilodus*, chiefly in the fewer cusps of the internal row, very feeble development of the median row, and squarer truncation of the end. The external two cusps are very like those of *Ptilodus mediævus* ("*Chirox plicatus*"), save for the presence of a basin between these and the mid-row, apparently related to the deficiency of the latter. The character of the cusps and of the enamel and the broader character of crown shape and structure are also sufficiently similar to warrant a tentative hypothesis of relationship.

?PRIMATES

?Plesiadapidæ

Cf. *Labidolemur* sp.

In the collection is a single upper molar (A. M. No. 22195) of very small size, measuring only 1.5 mm. anteroposteriorly. Paracone and metacone are conical, the protocone internal to the paracone. There are no external or internal cingula, but there is a narrow anterior cingulum and

¹ἁλὺς, frugal ὀφείλω, beast—from its want of prodigality in leaving evidence of its existence. *Complicatum*, from the form of the type tooth.

a broad basined posterior cingulum, without a definite hypocone. The tooth evidently belongs to a plesiadapid or tarsiod and resembles *Phenacolemur* save in its smaller size, absence of external cingulum, slightly less developed hypocone cingulum. For this reason it may well belong to *Labidolemur* which, as known from lower jaws, also resembles *Phenacolemur* but is also much smaller, and which is known to occur at Bear Creek (*L. kayi* Simpson). The present specimen seems too small for *L. kayi*, although it might belong here. The variety of these small primates (or insectivores) is so great, however, that little weight attaches to this reference.



Fig. 2. Cf. *Labidolemur* sp. Upper molar. Crown view. Four times natural size.

?PRIMATES

?Tarsiidae

Carpolestes aquilæ,¹ new species

TYPE.—Amer. Mus. No. 22233, Right lower jaw with P₄-M₃.

PARATYPE.—Amer. Mus. No. 22190, right lower jaw with P₄-M₂. Both type and paratype collected by R. Husband.

HORIZON AND LOCALITY.—Above Coal Vein No. 3, Fort Union Group. Eagle Mine, Bear Creek, Montana.

DIAGNOSIS.—Length P₄-M₂, 6.2 mm. P₄ about 10% smaller than in *C. nigridentis* and slightly smaller relative to the molars. Molars relatively narrower basally.



Fig. 3. *Carpolestes aquilæ*, new species. Right lower jaw with P₄-M₃. Type. Crown view. Three times natural size.

Various isolated specimens of P₄ suggested that two species were probably present, and the present material apparently establishes this.

From the adaptive type, one might suppose that this genus would have an enlarged gliriform incisor, but no incisor root is to be observed under P₄ in any specimen examined by me, nor is one present in *Carpodaptes*.

P₄-M₂ of *Carpolestes aquilæ* agree, save in proportions, with those of *C. nigridentis*. The present type reveals M₃ in this peculiar genus. As inferred, it is closely similar to that of *Carpodaptes* and is of tarsiod or plesiadapid type. The trigonid is short and is somewhat broader than that of M₂. As in the latter, the paraconid and metaconid are closely approximated, the former slightly smaller and more external, while the protoconid is lower than either. The talonid is similar in general structure to that of *Washakius* or *Plesiadapis*, for example, elongate, bilobed

¹In allusion to its source, the Eagle Mine.

(the posterior lobe the narrowest part of the tooth), distinct entoconid, double hypoconulid.

TÆNIODONTA

Stylinodontidæ

?*Psittacotherium lobbelli*,¹ new species

TYPE.—Amer. Mus. No. 22234. Isolated cheek tooth.

PARATYPES.—Amer. Mus. No. 22235, incisor. Carnegie Museum No. 11560, canine. Type and paratypes presented by J. F. Lobdell.

HORIZON AND LOCALITY.—Above Coal Vein No. 3, Fort Union Group, Eagle Mine, Bear Creek, Montana.

DIAGNOSIS.—Upper premolar (?) one-rooted, higher crowned than in *Psittacotherium multifragum*, but lower than in *Calamodon* and with external and internal band-like basal expansions of enamel only incipient. Lower canine with longer enamel band and more persistent growth than in *P. multifragum*, enamel not grooved longitudinally, enamel-free portion compressed transversely.

The canine has been described in the Annals of the Carnegie Museum, where it was pointed out that it does not belong to any previously established species. With the discovery of two more specimens, it seems best to assign a name to this little-known but clearly distinct form. The known material suggests that the Bear Creek animal is intermediate in structure between *Psittacotherium multifragum* and *Calamodon simplex*, but probably somewhat closer to the former.

The cheek tooth, Amer. Mus. No. 22234, is probably an upper premolar. The upper teeth are not well known in any tæniodont, and comparisons are hence difficult, but there are isolated teeth of *Psittacotherium* and of *Calamodon* in the collection, which, although of doubtful position, are apparently homologous with this tooth. The root is single, but with vestigial vertical sulci. The oval crown bears a large cusp on one side, from which there extends along one end a cuspidate ridge to a point near a smaller but

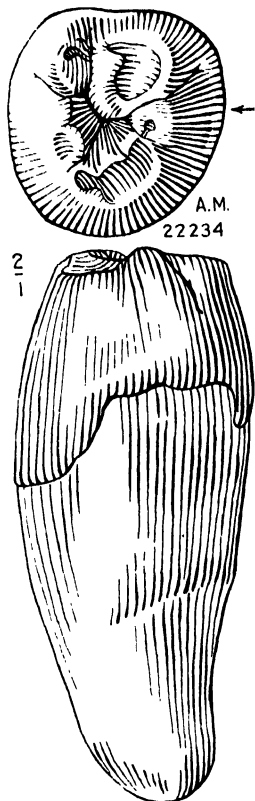


Fig. 4. ?*Psittacotherium lobbelli*, new species. Cheek tooth. Type. Crown and end views. Arrow in upper figure marks direction from which lower figure was drawn. Twice natural size.

¹In honor of Mr. J. F. Lobdell, superintendent of the Eagle Mine, discoverer of the species.

prominent cusp on the other side of the tooth. Below the main cusp, on the internal side, if this is truly an upper premolar, the enamel extends downward for some distance, forming an incipient band, while on the other side the extension is less marked and the enamel terminates in two sharp points. These characters are advances over *P. multifragum* and definitely foreshadow the more specialized *Calamodon*.

CONDYLARTHRA

Phenacodontidæ

Phenacodus cf. *primævus hemiconus* (Cope)

The facies of this deposit is such that ungulates, predominant in most fossil faunas, are excessively rare. In the American Museum collection there is only one tooth surely referable to this group, A. M. No. 22197. This is the right M^2 of a phenacodont. It is broken around the edges, but all the cusps are present and are almost unworn. It is much more progressive than *Tetraclænodon*, the Torrejon genus which occurs also in the Sweetgrass County (Fish Creek) Fort Union, and it has a very strong, distinct mesostyle. In point of evolutionary grade, the isolated tooth cannot be distinguished from Gray Bull (classic Wasatch) specimens. It agrees exactly in size and all other observable characters with a specimen from the Clark Fork referred to *Phenacodus primævus hemiconus*. It is possible, although improbable in view of this exact agreement, that a complete dentition would align this form rather with the long suspected but not yet exactly defined intermediate grade which

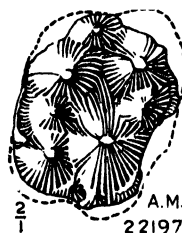


Fig. 5 *Phenacodus* cf. *primævus hemiconus* (Cope). Right M^2 . Crown view. Twice natural size.

is supposed to occur in the Upper Paleocene and to be transitional between *Tetraclænodon* on the one hand, and *Phenacodus* and *Ectocion* on the other. The latter genera do occur, typically developed, in the Upper Paleocene, however. But the exact reference is not very important, while the fact that this is a progressive and surely post-Torrejon type of phenacodont is established and is highly important.

AGE	SAN JUAN BASIN (N. M.—COLO.)	NORTHERN WYOMING	SOUTHERN MONTANA	CENTRAL ALBERTA	PRINCIPAL CHARAC- TERS OF VERTEBRATE FAUNAS
LOWER Eocene	LARGO	GRAY BULL ETC.	_____? ULM COAL GROUP	(Absent)	
	ALMAGRE				
	(Absent or non- fossiliferous)	SAND COULEE			First Perissodactyls, Artio- dactyls, Rodents, and Adapids } MARKED FAUNAL CHANGE
UPPER	_____?	CLARK FORK	PORT UNION	PASKAPOO	Last Champsoosaurs Last <i>Peripolychus</i> First <i>Phenacodus</i> , Monisco- theres, etc. <i>Plesiadapis</i>
	TIFFANY	_____?	SENTINEL BUTTE (Bear Creek Fauna)	_____?	
	TORREJON	(No Mammals)	TONGUE RIVER	(Absent or non- fossiliferous)	<i>Ptilodus</i> , <i>Chricacus</i> , <i>Clan- odon</i> , <i>Tetradactylodon</i> , <i>Pan- lambula</i>
MIDDLE			LEBO (Fish Creek Fauna)		
LOWER	PUERCO		TULLOCK (No Mammals)		First Carnivores and Un- gulates, <i>Taxiodonts</i> , <i>Tri- sodan</i> , <i>Ectacodon</i> , <i>Con- odon</i> } GREATEST FAUNAL CHANGE
UPPER CRETA- CEOUS	(Absent)	[LANCE]	HELL CREEK	(Absent?)	Last Dinosaurs. Mam- mals: Only Insectivores, Didelphids, and Multitu- berculates
	OJO ALAMO			EDMONTON	

Provisional Correlation of American Paleocene

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BEEES FROM THE AUSTRALIAN REGION

By T. D. A. COCKERELL

PART I.—NORTHERN TERRITORY OF AUSTRALIA

Some time ago Mr. Herbert F. Schwarz received from Mr. Charles Barrett an interesting collection of Australian bees, now placed in the American Museum. Among these I find a considerable series collected by G. F. Hill in the Northern Territory, principally at Port Darwin. The bee-fauna of this region is little known, and the material justifies a special report, in which I include the bees collected by myself at Port Darwin, March 12, 1928. Mr. Hill is well known for his important contributions to the knowledge of Australian termites.

***Palæorhiza turneriana viridimutans* Cockerell**

2 ♀, Port Darwin (Hill).

***Hylæus albonitens* (Cockerell)**

1 ♀, thirty miles east of Port Darwin (Hill).

***Hylæus baudinensis* (Cockerell)**

One from Port Darwin (Hill).

***Meroglossa eucalypti* variety *hilli*, new variety**

♂.—Scutellum pale yellow right across; stigma paler. Abdomen and legs dark reddish.

Port Darwin (Hill).

***Meroglossa deceptor* Perkins**

♀.—Clypeus and supraclypeal region, and also mesothorax, clear terracotta-red; tubercles entirely dark; scutellum and postscutellum red; axillæ pale yellow. Abdomen dark red suffused with blackish.

Port Darwin (Hill). Previously known only from the male.

***Paracolletes tropicalis*, new species**

♀.—Length, about or slightly over 6 mm.; black, with the mandibles and labrum clear red, tegulæ ferruginous, hind margins of abdominal segments broadly dark reddish-brown; knees broadly, anterior and middle tibiæ in front, hind tibiæ broadly at base and narrowly at apex, and all the tarsi, clear ferruginous. Head rather broad;

face, and some distance up sides of front, covered with pure white hair; flagellum obscurely reddened beneath. Thorax above with thin erect white hair; mesothorax polished, with widely spaced, strong punctures; scutellum shining, and with strong punctures; area of metathorax with a sharp transverse keel, above which is a shining space crossed by widely separated ridges. Wings clear; stigma well developed but not very large, rufous; nervures rather pale; basal nervure falling short of nervulus; second cubital cell very broad, receiving recurrent nervure a little before middle; third cubital about as broad above as second, receiving second recurrent a short distance from end. Abdomen shining, but distinctly and closely punctured; apical plate clear red. The most remarkable feature is the very short flagellum (for a male); it is not so long as the eye.

Melville Island (G. F. Hill).

It is among the minute species readily known by the short dark flagellum, combined with red mandibles and largely red legs.

***Halictus woodsi* Cockerell**

2 ♀, Port Darwin at *Eucalyptus* (Cockerell); 1 ♀ (Hill).

The color of the mesothorax varies, and I now think that *H. behri* Cockerell, with brilliant blue mesothorax and blue clypeus, is probably only a variation. The name *Halictus behri* has priority of place.

***Halictus dampieri* Cockerell**

5 ♀, Port Darwin, at *Eucalyptus*, (Cockerell); 1 ♀, October 9, 1915 (Hill).

***Halictus murrayi* Cockerell**

3 ♀, Port Darwin, at *Eucalyptus*, (Cockerell).

Very near to *H. pavonellus* Cockerell, differing by the black abdomen and legs. *H. murrayi* was previously known only from the holotype in the British Museum.

***Halictus eyrei darwiniensis*, new subspecies**

♀.—Differs only in the coloration of the abdomen which, instead of being clear red, is very dark brown, almost black, often with the base more or less red.

5 ♀, January 1, 1915, Port Darwin, Northern Territory (Hill). This was labelled *H. sphecodopsis* Cockerell, but that was based on a male with dark reddish-brown stigma, and the face with yellowish hair.

***Halictus hilli*, new species**

♂.—Length, about 6 mm.; head and thorax steel-blue, the mesothorax and clypeus somewhat greenish, scutellum with the polished impunctate disc olive-green, strongly contrasting with the pure-blue metathorax; mandibles rather dark red. Head broad, eyes very strongly converging below; clypeus dullish, with distinct,

separate punctures; flagellum moderately long, deep castaneous beneath; hair of head and thorax thin, white. Mesothorax polished, with scattered punctures; mesopleura rather dull; area of metathorax with very strong longitudinal plicæ, and sharply limited posteriorly; posterior truncation glistening, sharply limited at sides; tegulæ rufous. Wings clear, iridescent; stigma dark reddish; nervures pale brown; second and third cubital cells alike, small and narrow; first recurrent nervure joining second cubital cell a little before the end, outer nervures evanescent. Legs dark brown, with anterior tibiæ in front, and all the tarsi, pale reddish. Abdomen steel-blue, broadly reddened at bases of third and fourth segments (when the abdomen is contracted, this will hardly be evident, but the apices of the segments before are somewhat reddened).

SCULPTURAL CHARACTERS (MICROSCOPIC).—Front strongly longitudinally striate at sides, but in middle, below the ocelli, strongly transversely striate, this transverse striation extending at least as far down as the level of the middle of the scape. Mesothorax finely lineolate, sparsely punctured, and with delicate oblique plicæ at sides; scutellum very sparsely punctured; area of metathorax with variously imperfect transverse rugæ at right angles to the large longitudinal ones.

Port Darwin (G. F. Hill).

Related to *H. caloundrensis* Cockerell, but with lighter stigma and different coloration, so I think it is not its male. It is not the male of *H. woodsi* Cockerell, which has the tibiæ ferruginous in this sex, and the flagellum much shorter. In having the striæ before the middle ocellus transverse, it departs from *H. caloundrensis* and resembles *H. behri transvolans* Cockerell, which is very different in other respects.

***Halictus nigropolitus*, new species**

♀.—Length, nearly 6 mm.; robust, with very broad abdomen; pure black, including legs, shining, with scanty grayish-white hair on head and thorax, conspicuous around tubercles. Head broad; mandibles red in middle; clypeus very short, highly polished, with scattered punctures; supraclypeal area shining; malar space obsolete; front dull, glistening at sides; sides of vertex shining; scape long; flagellum dusky reddish beneath. Mesothorax highly polished, with rather numerous scattered punctures; scutellum polished, strongly shining, with no median sulcus; area of metathorax semilunar, short, bounded by an obtuse shining rim; surface of area rugulose, the separate plicæ not well defined, the sculpture coarse; mesopleura dull and rough; tegulæ shining rufous, dark at base. Wings clear; stigma large, very dark reddish; outer recurrent and intercubitus evanescent; third cubital cell much larger than second; first recurrent meeting second intercubitus. Legs with pale hair, a red tuft at end of hind basitarsi. Abdomen shining black, very finely punctured, with very little hair, and no bands or spots; venter with long white hair, forming a scopa.

SCULPTURAL CHARACTERS (MICROSCOPIC).—Hind spur with a long stout spine, and a low rounded lamella. Front very densely punctured, not at all striate. Punctures of anterior part of mesothorax of two sizes, the larger ones more or less definitely in rows; postscutellum very finely punctured, its posterior portion with very fine striæ; rugæ of area of metathorax wrinkled or vermiform, forming a sort of irregular network.

1 ♀, Port Darwin (Cockerell).

In various tables this runs persistently to the vicinity of *H. sturti* Cockerell, from which it is easily known by the sculpture of the mesothorax; it is also less robust. From *H. helichrysi* Cockerell it is easily distinguished by the almost bare abdomen. It is near *H. semipolitus* Cockerell, but much larger and more robust, and the area of the metathorax differs. It is easily distinguished from *H. blackburni* Cockerell by the shining thorax. The dark stigma shows that it cannot be the female of *H. bursariae* Cockerell.

***Nomia melvilliana*, new species**

♂.—Length, a little over 7 mm.; black, almost exactly like *N. kurandina* Cockerell, for which I at first took it, but certainly distinct by the shorter flagellum, which is somewhat over 2 mm. long (about 3.3 mm. in *kurandina*). It also differs in being less robust, with the hair on the face dull and slightly yellowish (not pure white as in *kurandina*). The flagellum is conspicuously dark red beneath; the punctures of the mesothorax finer than in *kurandina*; tegulae pale testaceous; hair of postscutellum tinted with reddish in middle; spot at wing-tip smaller and more sharply defined, not spreading far from costa; anterior femora ferruginous apically, their tibiae entirely red in front, middle and hind basitarsi pallid, darkened apically; first abdominal segment with a small dense spot of white hair on each side, second with a short dense white hair-band on each side, third with a broadly interrupted band, very much narrower than the band on *kurandina*, fourth with only thin inconspicuous hair.

Type from Melville Island (G. F. Hill). There is also one (without head) collected by Hill at Port Darwin.

Nomia macularis Friese, from Mackay, is doubtless *N. kurandina* Cockerell, though the description does not fit quite well. I have *N. kurandina* from Mackay.

***Allodape simillima* Smith**

1 ♀, Port Darwin (Cockerell); 1 ♀, Port Darwin (Hill); 1 ♀, Melville Island (Hill).

***Allodape unicolor* Smith**

1 ♀, 1 ♂, Port Darwin (Cockerell); numerous specimens taken by Hill at Port Darwin.

***Allodape diminuta* Cockerell**

One from Port Darwin (Hill).

***Mesotrichia bryorum* Fabricius**

1 ♀, Port Darwin (Hill). This species was one of the discoveries of Cook's first expedition.

***Anthophora æruginosa* Smith**

1 ♀, Port Darwin, October 27, 1914 (Hill).

***Anthophora walkeri* Cockerell**

1 ♂, 1 ♀, Melville Island; 1 ♀, Port Darwin. All were collected by Hill.

The color of the abdominal bands varies from emerald-green to pale blue.

***Anthophora chlorocyanea* Cockerell**

2 ♀, one from Melville Island, the other from Port Darwin (Hill).

Not quite typical, but I cannot separate the specimens from *A. chlorocyanea*.

***Crocisa omissa* Cockerell**

1 ♂, Daly River, February 21, 1915 (Hill); 1 ♀, thirty miles east of Port Darwin (Hill).

***Crocisa lamprosoma* Boisduval**

1 ♀, Roper River (Hill).

***Lithurgus rubricatus* Smith**

1 ♂, Pine Ck. (Hill). I suppose Ck. stands for Creek.

***Megachile barvonensis* Cockerell**

1 ♂, Port Darwin (Hill).

This specimen was compared with the type.

***Megachile sequior* Cockerell**

1 ♀, Port Darwin, February 13, 1914 (Hill).

***Megachile cetera* Cockerell**

1 ♀, Port Darwin (Hill).

***Megachile dinognatha* Cockerell**

1 ♀, Roper River, Northern Territory (Hill).

I described this recently from a specimen in the Queensland Museum taken by H. H. Batchelor at Hughenden, Queensland, on the edge of the Richmond Downs. The female resembles *M. macleayi* Cockerell, but is larger and much more robust. The head is very large; the eyes are very strongly diverging below; the clypeus is extremely short and broad, with its lower edge finely crinkled; the mandibles are massive, broadened

apically. The wings are dark fuliginous; the metathorax with white hair. There is a large bright ferruginous patch on the apical part of the abdomen, beginning on the margin of the fourth tergite; the ventral scopa is light reddish.

***Megachile leucopogon*, new species**

♂.—Length, about 7 mm.; black, rather robust; mandibles, long slender flagellum, and legs, all black; eyes pale reddish. Head large, eyes moderately converging below; face and front densely covered with long, pure white hair; under side of head with long white hair; vertex closely punctured, with thin pale hair. Thorax with white hair, tinged with creamy dorsally, very thin on mesothorax; mesothorax and scutellum somewhat glistening, but very finely and closely punctured; tegulae dark rufous. Wings hyaline, faintly dusky apically; stigma and nervures brown. Legs with white hair; anterior coxae polished, with short sharp spines; anterior femora reddened on face opposed to tibiae; anterior tarsi little modified, but the joints are thickened, with much white hair; hind tibiae with conspicuous pure white hair at apex; hind tarsi thickened. Abdomen short and broad, the segments with narrow entire pale ochreous-tinted hair-bands; the first segment covered with pale hair, except a subapical band; the sixth dorsally covered all over with dense white hair; the transverse keel deeply emarginate and bilobed.

Port Darwin (G. F. Hill).

I hesitated whether to place this as the male of *M. cetera* Cockerell, but it seems too different from the female, though evidently allied. From the male of *M. timberlakei* Cockerell (near which it runs in my table) it is readily known by the rounded (not dentate) apical lobes of the abdomen the stouter tarsi, and the much shorter and broader hind basitarsus. The middle tarsi have very long white hair behind, which is not true of *M. timberlakei*. The light hair on the fifth tergite and other characters separate it from *M. palmarum* Perkins.

***Megachile ignescens*, new species**

♀.—Length, 10.5–11.5 mm.; black, broad, thorax not spotted, abdomen with narrow entire dull-white hair-bands, the dorsal surface with metallic colors, not always distinct; ventral scopa bright ferruginous, black on apical part of last segment. Mandibles black, very broad; clypeus convex, densely punctured, but rather broadly shining in middle; supraclypeal area strongly punctured; antennae entirely black; face and front with cream-colored hair, but thin inconspicuous black hair on disc of clypeus; cheeks with white hair, vertex with black. Mesothorax and scutellum glistening, but well punctured, anteriorly the mesothorax is dullish and very densely punctured; discs of mesothorax and scutellum with rather short black hair; white hair in scutello-mesothoracic suture, and much white hair on pleura and metathorax; mesopleura extremely densely and finely punctured; tegulae black. Wings dusky; second cubital cell very long. Legs stout, very dark reddish, their hair pale, on inner side of tarsi red; hind basitarsi with black hair on hind margin; middle tarsi very thick; hind basitarsi broadened. Abdomen shining, finely punctured.

2 ♀.—Type from Melville Island (Melville Island is a large flat island just off the coast by Port Darwin; it can hardly be expected to have a fauna different from that of the adjacent mainland); cotype from Port Darwin, both collected by Hill.

Runs next to *M. pictiventris* Smith, but it is smaller, and easily known by the white hair-bands on the abdomen. It is also somewhat related to *M. hæmatogastra* Cockerell.

***Megachile tenuicincta*, new species**

♀.—Type. Length, nearly 10 mm.; black, of the style of *M. quinquelineata* Cockerell, with mostly white (not fulvous or ochraceous) pubescence, black on vertex and scutellum, and scattered black hairs on mesothorax; ventral scopa shining white, black on last segment. Mandibles black, broad, quadridentate; clypeus dull, extremely densely and finely punctured, the lower margin shining; supraclypeal area well punctured, but with a broad polished space in middle anteriorly; flagellum with a very faint reddish tinge below; vertex very closely punctured. Mesothorax and scutellum finely and extremely densely punctured, suture between them filled with dense white tomentum; tegulæ black. Wings hyaline, very faintly dusky. Legs with white hair, reddish on inner side of tarsi; middle tarsi thick and very hairy; hind basitarsi broadened. Abdomen somewhat shining, well punctured, with five narrow entire white hair-bands.

♂.—Length, about 8 mm.; broad and compact. Face and front covered with white hair; long black hairs at sides of face and base of clypeus; flagellum slender, black. Legs very dark reddish; anterior coxæ with rather long sharp spines; anterior tibiæ more brightly colored apically in front; anterior tarsi dark brown, not much modified, but the basitarsi have posteriorly a long-oval black lobe; middle and hind tarsi thick, the hind basitarsi very short and stout. Abdomen short and broad, with very narrow pure white hair-bands; fifth segment with no pale hair on disc; sixth above very densely covered with pure white tomentum; the keel with a pair of broad rounded lobes separated by a deep emargination; venter reddened, with dense white hair bands.

Type (♀) taken thirty miles east of Port Darwin; 1 ♂, 1 ♀, Port Darwin; 1 ♂, near Port Darwin. All were collected by Hill.

Both sexes run near the Hawaiian *M. palmarum* Perkins, but are easily separated by the pubescence, especially the long black hair on the head and the thorax above in both sexes. In this feature *M. tenuicincta* resembles *M. quinquelineata* Cockerell, from which it is easily separated (♀) by the dense white hair forming the posterior fringe of the hind tarsi, this in *M. quinquelineata* being long and black. By the tarsal hair it falls rather with *M. cetera* Cockerell, which lacks the long black hair on the thorax above, and has a median smooth line or band on the clypeus.

***Cœlioxys albolineata* Cockerell**

1 ♂, near Port Darwin (Hill).

***Coelioxys albolineata* variety *darwiniensis*, new variety**

♂.—Mesothorax dark red, black along posterior margin. Legs dark red, the femora rather bright.

1 ♂, Port Darwin (Hill).

The peculiar coloration suggests a distinct species, and Holmberg in dealing with the Argentine species makes the red or black mesothorax a prime character for the separation of species in his key. Nevertheless, after close comparisons, I am confident that the present insect represents no more than a color-variety.

***Trigona carbonaria*¹ Smith**

I took five at Port Darwin, and Hill collected the same number at the same place.

PREVIOUS RECORDS

The following species have been previously recorded from Port Darwin.

Hylaeus baudinensis Cockerell

Euryglossa euzantha Perkins

Euryglossa subfusa Cockerell

Meroglossa decipiens Perkins

Palæorhiza turneriana viridimutans Cockerell

Turnerella doddi Perkins

Nomia darwinorum Cockerell

Crocisa darwini Cockerell

Halictus behri Cockerell

Halictus urbanus Smith

Halictus woodsi Cockerell

Anthophora æruginosa Smith

Anthophora darwini Cockerell

Megachile darwiniana Cockerell

Megachile micrerythra Cockerell

Thaumalosoma turneri M.-W.

The following species have been previously recorded from Adelaide River, Northern Territory.

Paracolletes colletellus Cockerell

Palæorhiza perviridis Cockerell

Halictus murrayi Cockerell

Anthophora adelaida Cockerell

Trigona laviceps Smith

The following species have been previously recorded from Port Essington, Northern Territory.

Meroglossa canaliculata Smith

Nomia ænea Smith.

Megachile mystacea Fabricius

Trigona essingtoni Cockerell

¹Since writing the above I have received from Mr. Harold Hockings a series of *Trigona* which he collected on the Cape York Peninsula. They are in general exactly like *T. carbonaria*, but distinctly larger, with the flagellum clear red beneath, and the scutellum with much coarse black hair. Mr. Hockings finds that they differ in their nesting habits, building a large cellular excrescence over the entrance to the nest. This is not *T. angophoræ* Cockerell, but is a species or subspecies very close to *T. carbonaria*. I call it *T. carbonaria hockingsi*, new subspecies. On re-examining my specimens of *T. carbonaria* which I collected at Port Darwin, I find they are referable to subspecies *hockingsi*, though the red of the flagellum beneath is not so bright.

PART II.—VICTORIA, NEW SOUTH WALES, QUEENSLAND,
AND NEW BRITAIN

The bees recorded in Part II of this paper were mostly sent by Mr. Charles Barrett to Mr. H. F. Schwarz some years ago, but I have added a certain number of species from my expedition of 1928, and one species was received from Dr. Friese.

Euprosopis elegans (Smith)

2 ♀, Ararat, Victoria (G. F. Hill).

Hylæus nubilosus subnubilosus (Cockerell)

♀, Victoria (G. F. Hill).

This is distinctly *subnubilosus*, notwithstanding the southern locality.

Hylæus perhumilis (Cockerell)

♂, Seaford, Victoria (W. F. Hill).

It is like the Tasmanian race.

Hylæus asperithorax (Rayment)

Euryglossa asperithorax Rayment, Victorian Naturalist, July, 1927, p. 75.

It is very near to *H. eugeniellus* (Cockerell), but distinct (♀) by the smaller face-marks, and by the quite dull mesothorax, which is minutely roughened and punctured instead of microscopically reticulate as in *H. eugeniellus*.

Callomelitta picta variety **wilsoni**, new variety

The abdomen black, banded with bright green. The femora all dark.

1 ♀, Eltham, Victoria, April 27, 1918 (F. E. Wilson).

Paracolletes maximus, new species

♂.—Length, about 17 mm., anterior wing 10 mm.; black, robust. Malar space linear; mandibles black, reddened in middle, not elbowed, the basal tubercles very large, the lower margin with very long hair; clypeus dull, depressed in middle, sparsely and weakly punctured; scape slender, very long; third antennal joint much longer than fourth; antennæ from fourth to ninth joint red beneath; vertex dull; cheeks with long white hair beneath, but hair of head otherwise fulvous, becoming creamy white at the sides of the face. Mesothorax dull and, like the scutellum, densely covered with thick moss-like very bright fox-red hair; tubercles with hair of the same color; thorax at sides and posteriorly with very long creamy-white hair; area of metathorax dull, without evident sculpture; tegulæ dark rufous, thickly tufted with red hair in front. Wings brownish, stigma and nervures dark fuscous; stigma rudimentary; basal nervure practically straight in its lower part, falling short of nervulus; second cubital cell very broad, moderately contracted above, receiving first recurrent

nervure at its middle; third cubital about as broad above as second, produced apically, receiving the second recurrent nervure a considerable distance from the end; the marginal cell truncate at apex. Legs black, with long pale hair; spurs extremely short; hind tibial scopa shining white or creamy-white, dark fuscous for a short distance beyond the knee-plate. Abdomen dull black, without evident punctures, very finely and thinly tomentose; hind margins of segments very narrowly pallid, second to fourth with narrow white hair-bands; fifth with long creamy-white hair, and red hair at each side of the large anal plate; venter with broad white hair-bands.

Victoria (Hill). No other data available.

The first cubital cell is hardly as long below as the next two combined, and the species, like some others, might as well go in *Anthoglossa* as *Paracolletes*. It does not, however, have the peculiar mandibles of *A. plumata* Smith. The species will be readily known by the large size and bright red, moss-like hair on the thorax above.

***Paracolletes fimbriatinus* Cockerell**

3 ♂, Ararat, Victoria (G. F. Hill).

***Paracolletes abdominalis* Smith**

♀, Bamawm, Victoria (W. F. Hill).

This species was described from Champion Bay, W. Australia. The present specimen differs perhaps a little in the more or less infuscated anterior and middle tibiae and the pale snuff-brown rather than fulvous hair at the apex of the abdomen, but it cannot well be separated. The clypeus is shining and very coarsely punctured, without a median keel, and the flagellum is bright red beneath except at the base. The ferruginous stigma is small, but not subobsolete. The second recurrent nervure ends a little distance from the end of the third cubital cell, not very close to the end as in Smith's type. The bright-red abdomen has no bands, but much erect white hair on the first segment.

***Paracolletes carinatus* (Smith)**

3 ♂, Scaford, Victoria (W. F. Hill).

***Paracolletes melbournensis* Cockerell**

1 ♀, Ararat, Victoria (G. F. Hill).

***Euryglossa leptospermi* Cockerell**

2 ♀, Bamawm, Victoria (W. F. Hill).

***Euryglossa albosignata*, new species**

♀.—Length, 8 mm.; head black; flagellum bright ferruginous beneath. Mesothorax, scutellum, and postscutellum except sides, very bright red. Legs black, with knees reddish, small joints of tarsi clear red. Wings clear hyaline, stigma dusky red,

nervures pallid; tegulae dark reddish. Abdomen broad, with a dull surface, green, with the hind margins of the segments blackened. Extremely similar to *E. aurescens* Cockerell, but easily known by the very dense, pure white hair forming a patch on each side of the narrower face; also by the red on the postscutellum, and the second recurrent nervure meeting the outer intercubitus. The mesothorax is finely and closely punctured anteriorly.

Bamawm, Victoria (W. F. Hill).

***Parasphecodes plorator* Cockerell**

1 ♀, Jenolan, New South Wales, at flowers of *Helichrysum lucidum* (syn. *H. bracteatum*), April 29 (W. P. Cockerell).

***Parasphecodes vermiculatus* Cockerell**

1 ♂, Beaumaris, Victoria, at flowers of *Achillea*, March 31 (Cockerell).

Related to *P. solis* Cockerell, but differs as follows: flagellum all black, first recurrent nervure reaching the third cubital cell, the wings not reddish, an apical cloud present.

***Parasphecodes wellingtoni griseipennis*, new subspecies**

♀.—Wings grayish instead of reddish; sides of front dull, with minute sculpture between the punctures; mesothorax duller anteriorly; flagellum hardly reddish below.

Jenolan, New South Wales, at flowers of *Helichrysum lucidum*, April 29 (W. P. Cockerell). The typical *P. wellingtoni* Cockerell occurs in Tasmania.

***Parasphecodes wilmattæ*, new species**

♀.—Length, about 9.5 mm.; robust, head and thorax black, abdomen with first three segments rich chestnut-red, the others black; mandibles, labrum, antennæ, tegulae and legs all black; thorax broad and robust, its hair and that of head thin, dull white, with a faint creamy tint dorsally. Clypeus shining, with large scattered punctures, and a strong median sulcus not reaching base or apex; supraclypeal area convex, somewhat shining but not polished, with well-separated punctures; front and sides of face dull. Mesothorax and scutellum dull, closely punctured; punctures of mesothorax visible under a lens; area of metathorax large, rounded behind, with weak radiating plicæ, the surface between them microscopically lineolate; pleura dull and rough. Wings strongly grayish, darker apically; stigma and nervures dark sepia; basal nervure falling just short of nervulus; second cubital cell broad, approximately square; first recurrent nervure meeting second intercubitus. Legs with pale hair, reddish on inner side of anterior tarsi. Abdomen broad, shining, its punctures minute and not dense evident only under a microscope; no black mark on first segment; no ventral tubercle.

Jenolan, New South Wales, at flowers of *Helichrysum lucidum*, April 29 (W. P. Cockerell).

This insect approaches *P. gibbosus* (Fries), but the area of the metathorax is much shorter, and not broadly squared off behind; the red of the abdomen is brighter. It runs out in Meyer's and my various tables.

***Parasphecodes tripunctatus*, new species**

♂.—Length, about 9 mm.; rather slender, head and thorax black; abdomen with the first three tergites bright chestnut-red (the first with a dusky T-mark), the others black or reddish black, the fourth with a transverse red band (as in the considerably smaller *P. minimus* Meyer, from Port Philip); tegulae clear bright ferruginous; anterior tibiae red, rather dusky behind; small joints of anterior tarsi reddened apically, but legs otherwise black; clypeus with a very broad lemon-yellow band, having a large pointed median extension upward; on the yellow are three black spots, one at each side, and one just below the base of the extension. Hair of head and thorax dull white, tinted with ochreous on vertex and scutellum, short and thin on mesothorax; sides of face and front densely hairy, with an ochreous tint; antennae broken in type, but base of flagellum (and presumably the rest) all black. Area of metathorax unusually small, rounded behind, sharply defined, with short strong plicae, the surface between them glistening; other parts of metathorax conspicuously hairy. Wings long, hyaline, dusky apically; stigma rather pale reddish brown, nervures fuscous, basal nervure falling conspicuously short of nervulus; second cubital cell broad; first recurrent nervure meeting second intercubitus. Abdomen moderately shining, very finely and closely punctured; a deep constriction between first and second tergites; venter not tuberculate.

Ararat, Victoria (G. F. Hill).

Among Smith's species this falls nearest *P. talchius*, but it is readily separated by the sculpture of the metathorax and by other characters. It is also related to *P. froggatti* Cockerell and *P. minimus* Meyer. *P. froggatti* is more robust and very hairy. I had to consider whether this could be the male of *P. fultoni* Cockerell, which occurs at Ararat, but the area of the metathorax is quite different.

***Halictus bicingulatus* Smith**

1 ♀, Seaford, Victoria (W. F. Hill).

***Halictus niveifrons* Cockerell**

1 ♂, Sandringham, Victoria, April 1 and 6 (Rayment and Cockerell).

***Halictus flindersi thor*, new subspecies**

♀.—Length, about 6 mm. Clypeus and supraclypeal area brilliant coppery red, or only suffused with this color; basal half of scape red. Mesothorax and scutellum shining yellowish green, the mesothorax punctate, not plicatulate; area of metathorax large, with strong irregular rugae; tegulae bright ferruginous. Wings hyaline, stigma dark brown, nervures pale fuscous. Femora green; knees, tibiae, and tarsi chestnut-red. Abdomen shining dark blue-green, the depressed portions of the segments more steel-blue; a large, curled, slightly yellowish ventral scope.

3 ♀, Thursday Island, March 15 (Cockerell).

Agrees structurally with *H. flindersi* Cockerell, but the coloration is strikingly different.

***Halictus lanarius* Smith**

1 ♀, 1 ♂, Victoria (Hill); 1 ♀, Jennings, New South Wales, April 25 (Cockerell). Jennings (alt. 2875 ft.) is the name of the New South Wales part of the border town, which is called Wallangarra on the Queensland side.

***Halictus mesembryanthemi* Cockerell**

1 ♀, Beaumaris, Victoria, March 31 (Cockerell).

***Halictus erythrurus* Cockerell**

1 ♀, Croydon, Victoria (W. F. Hill).

***Halictus orbatus* Smith**

1 ♀, Jennings, New South Wales, April 25 (Cockerell).

***Halictus victoriæ* Cockerell**

1 ♀, Beaumaris, Victoria, at flowers of *Achillea*, March 31 (Cockerell).

***Halictus microchalceus*, new species**

♂.—Length, slightly over 3 mm, wings hardly 2.5 mm. Head small and rather narrow, dull yellowish green, brighter on vertex and somewhat shining before ocelli; lower margin of clypeus black, with no light band; the mandibles dark; face with thin white hair, beautifully plumose, not hiding the surface; antennæ black, the flagellum rather short; thorax with thin white hair; mesothorax dull, moderately shining anteriorly, yellowish green with a brassy or perhaps slightly coppery tint; scutellum yellowish green, shining; area of metathorax blue-green, large, semilunar, with radiating plicæ; posterior truncation small, dull, not very sharply defined; tegulae reddish. Wings hyaline, stigma very dark brown, nervures pallid; third cubital cell hardly as broad as the second; outer recurrent and intercubitus excessively weak; first recurrent nervure joining second cubital cell near end. Femora black, tibiae pale red at both ends, tarsi reddish. Abdomen rather narrow, shining, thinly hairy, greenish-black, the hind margins of the segments pure black; extreme apex reddish; venter dark.

SCULPTURAL CHARACTERS (MICROSCOPIC). Front entirely dull and very minutely sculptured, longitudinally striate. Mesothorax and scutellum with an excessively fine dense reticulation, and minute punctures; area of metathorax with the very delicate plicæ curved and intertwined, like a mass of fine roots; tegulae not punctured.

Thirroul, New South Wales, March 25 (Cockerell).

This excessively minute species may be compared with *H. hackeriellus* Cockerell, but is easily distinguished by the much narrower head and the color of the legs. The color of the mesothorax prevents us from associating it with the Tasmanian *H. limatus* Smith.

***Halictus granulithorax* Cockerell**

1 ♀, Melbourne Botanical Garden, April 9 (Rayment and Cockerell).

***Halictus barretti*, new species**

♀.—Length, about 5.5 mm., anterior wing 4.2 mm.; black, robust, with very broad abdomen. Hair of head and thorax dull white, with a suggestion of ochreous dorsally; face broad, clypeus shining, front dull; antennæ black, the flagellum reddened beneath apically. Mesothorax moderately shining but not polished, with minute but distinct punctures; scutellum shining; area of metathorax rugulose; tegulae dark rufous. Wings brownish hyaline, stigma dusky ferruginous, nervures pallid, outer intercubitus and recurrent hardly visible; basal nervure falling a little short of nervulus; third cubital cell quadrate, much larger than second. Anterior and middle knees, and spot at apex of middle tibiae, red. Abdomen shining, hind margins of second and following segments reddish; lateral bases of second and third segments with broad patches of grayish-white tomentum; venter with thin long curved hair.

SCULPTURAL CHARACTERS (MICROSCOPIC).—Front excessively densely and minutely punctured, the punctures tending to run in oblique lines. Area of metathorax with fine vermiform rugæ on basal half, the apical half smooth except for microscopic reticulation (the area is thus in the type of *H. boreum* Cockerell, which is otherwise different); apex of area rounded, not sharply defined. The hind spur with two blunt, oblique teeth (thus different from *H. humei* Cockerell); the first abdominal segment very finely and quite closely punctured in the middle, but at each side there is a large impunctate region.

Seaforth, Victoria (W. F. Hill).

Named after Mr. Chas. L. Barrett, the well-known Australian naturalist, who transmitted the specimen to Mr. Schwarz.

In Tasmania is found a very remarkable species known only in the male, *H. macrops* Cockerell. It is robust, with a very broad abdomen, like a female. *H. barretti*, seen from behind, can readily be taken for *H. macrops*, having just the same sort of abdomen. It differs from *H. macrops* as follows: stigma darker; second cubital cell broader; eyes dark reddish; inner orbits more curved; face not so hairy; thorax less hairy, dorsal hair of thorax only about half as long, and with a faint ochreous tint; tegulae darker; surface of mesothorax less shining. Under the microscope the mesothorax of *H. macrops* shows sparse strong punctures on a non-sculptured surface, while *H. barretti* shows weaker punctures on a minutely lineolate surface. Allowing for the

difference of sex, I do not think it possible that the two forms can be identical, but surely *H. barretti* is closely allied, and will be found to have a robust male.

***Exoneura bicolor* Smith**

1 ♀, Beaconsfield, Victoria, January 1, 1918 (F. E. Wilson); 2 ♀, Wallangarra, Queensland, at flowers of *Hypochaeris*, April 26 (Cockerell).

***Allodape simillima* Smith**

1 ♀, Thursday Island, March 15 (Cockerell).

This is the largest Australian species.

***Allodape diminuta* Cockerell**

♀.—Length, about 5 mm.; facial mark inverse-pyramidal, very broad above; scape all black; tubercles light.

Thursday Island, March 15 (Cockerell).

***Allodape unicolor* Smith**

1 ♂, Thursday Island, March 15 (Cockerell).

A small species, but not smaller than *A. bribiensis* Cockerell and *A. diminuta* Cockerell.

***Allodape clarissima*, new species**

♂.—Length, 6.8 mm. Like *A. simillima* Smith, but scape with a white stripe in front. Clypeus broad, constricted in middle, ivory-white; small lateral face-marks; labrum white in middle. Tubercles white; tarsi pale red; pleura with much white hair.

Thursday Island, March 15 (Cockerell).

Perhaps a variety of *A. simillima*.

***Allodape plebeia*, new species**

♂.—Type. Length, 6 mm. Like *A. simillima*, but no lateral face marks; facial mark yellowish, very broad above, gradually narrowing to the truncate lower end; labrum all black; antennae entirely black; tubercles cream-color; stigma very dark.

♀.—Length, about 6 mm. Marked like the male but more robust, with considerably broader abdomen. Hind legs with much silvery-white hair.

Thursday Island, March 15 (Cockerell).

***Asaropoda anomala*, new species**

♂.—Type. Appearing exactly like *A. bombiformis* (Smith), with broad bare black band at base of second tergite, but easily distinguished by the third antennal joint, which is short and thick (instead of long and slender), and by the longer flagellum, its length fully 5.5 mm. (instead of about 4). The clypeus is slightly keeled, but

without black markings, except a margin. The femora are red, the posterior ones a little dusky beneath; the sides of hind legs all red. Red hair of abdomen with a beautiful shining golden lustre, very minutely bilobed (without the distinct angles of *A. bombiformis*).

♀.—Like *A. bombiformis*, but rather larger and more robust. Hair-bands of second and third tergites broad, the anterior half greenish; hair of fourth and fifth segments greenish, with a beautiful golden lustre. The third antennal joint is long and slender, about as in *A. bombiformis*, but the antennæ are somewhat longer than in that species.

1 ♀, 1 ♂, Brisbane, Queensland, a pair without other data.

The distinctive characters of this species, which in so many other respects resembles *bombiformis*, were a great surprise to me. I suppose the species has been passed over as *A. bombiformis*, for which it would be taken on casual inspection.

Anthophora æruginosa Smith

1 ♀, Townsville, Queensland (G. F. Hill).

Anthophora zonata (Linnæus)

♀, Brisbane, Queensland; Jennings, New South Wales, at flowers of *Teucrium racemosum*, April 28 (Cockerell). 7 ♂ Thursday Island, March 15 (Cockerell, W. P. Cockerell, Alice Mackie, A. Foote).

The males agree with *A. zonata* as restricted and defined by me in 1911.

Anthophora vigilans Smith

Length, about 10 mm. Face-marks dull yellow; clypeus with two black marks like human feet; lateral face-marks filling space between clypeus and antennal toruli; labrum and labial palps yellow in front. Abdominal bands fulvous, shining coppery, with black beneath.

Length, about 10 mm. District, New Britain (G. F. Hill).

These are much smaller than Smith's female type, but appear to be the same species.

Megachile mystacea (Fabricius)

1 ♀, Townsville, Queensland (G. F. Hill); Brisbane.

Megachile hilli, new species

Length, about 5.5 mm. Form and aspect of *M. mystacea* (Fabricius), and determined by the collector, but easily separated by the following characters: mesoscutum with a broad anterior face (separated by a sharp keel from the outer surface) and polished; clypeus densely punctured laterally, shining and with yellow markings in middle, the lower margin with a couple of projections (style of *M. pacifica*); supraclypeal area broad, flattened, shining, with sparse,

fine punctures; clypeal region with very thin black hair, but side covered with black hair, going up to a little above level of antennæ; down to margin of supraclypeal area in middle, densely covered with antennæ black, with extreme tip of last joint reddish. Mesothorax shiny, tures sparse on disc; area of metathorax and adjacent parts entirely dark are very dark. Hind basitarsus extremely broad, with black hair on outer dark red on inner; the hind tibia has black hair on outer side, and short hair on inner, and the same is true of its femur. The abdomen is densely red hair above and below, but the first segment has black hair except along

Townsville, Queensland (G. F. Hill).

I had to consider whether this could be the female *ustulatiformis* Cockerell, and, while this is possible, it appears improbable. It is closely related to *M. placida* Smith, described from Gilolo Moluscas.

Megachile clotho Smith

1 ♀, Beining District, New Britain (G. F. Hill).

Megachile pictiventris Smith

3 ♀, Brisbane, Queensland.

Megachile ignescens Cockerell

2 ♀, Townsville, Queensland (G. F. Hill).

Megachile ventralis Smith

2 ♀, Beining District, New Britain (G. F. Hill).

Very close to *M. pictiventris* Smith, but the abdomen, seen from above, shows much long black hair at the sides. It was originally described from Amboina, but Friese has recorded it from New Britain. It is desirable to make direct comparison with Amboina specimens. Smith's short description appears to be fully applicable. examples of *M. ventralis* in the Hope Museum at Oxford notes.

Megachile aurifrons Smith

1 ♀, Seaford, Victoria (W. F. Hill).

Megachile rhodogastra Cockerell

2 ♂, Brisbane, Queensland.

In the British Museum, Meade-Waldo placed this as *pictiventris* Smith, although the abdomen is not at all

Megachile latipes Smith

1 ♂, Victoria (Hill).

I. A. R. I. 75.

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